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MAGAZINE

VOLUME 8 NUMBER 9
MAY 16, 1989

PC Lab Notes: A Guide to Matching Hard Disks and Controllers

FORWARD-LOOKING, BACKWARD-COMPATIBLE

PC Labs Tests 19 Multiscanning Monitors For VGA and Super VGA

Plus:

- 6 Heavy-Duty Project Managers
- 8 Training Tapes for DTP
- 6 Network Solutions For Modem Pooling

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WHAT'S INSIDE



Associate editor Kellyn S. Betts takes a close look at multiscanning monitors for nineties-era computing.

They may all look the same to the uninitiated, but after spending 2½ months with this multitude of monitors (researching, procuring, reviewing, testing, photographing, and so forth), project leader Robert W. Kane, editorial assistant Matthew J. Ross, and I can easily tell them apart. And after you read the reviews of these 19 multiscanning color monitors, you'll be able to differentiate between them as well.

All of these monitors are worthy of consideration if, like many of us at *PC Magazine*, you're betting that Super VGA's 800- by 600-pixel resolution will become the next color video standard. Besides giving you compatibility with older standards like EGA and CGA, these 12- to 14-inch monitors give you VGA for today, while at the same time giving you the flexibility to move up to Super VGA.

However, Super VGA is still in its infancy, so we would be remiss if we failed to tell you of the consensus reached at our monitor "reality check." One of executive editor Bill Howard's favorite catchphrases, a reality check is what you'd expect it to be: a test to substantiate our editorial assumptions, in this case to ensure that members of our editorial staff felt our Editor's Choice monitors were indeed impressive.

We lined up our Editor's Choices, the NEC MultiSync Plus and the Taxan MultiVision 770 Plus, together with our honorable mention, the Samsung Sync Master CN4551. Then we added a red herring: the Zenith FTM-1490 VGA-only monitor. Only 1 of the 11 editors we induced into filing past this lineup identified a monitor other than the Zenith as his personal first choice for his own desktop (the lone individualist chose the Samsung monitor). This resulted in spite of the fact that we displayed two of the multiscanning monitors at Super VGA's higher resolution.

But it's really not fair to compare the Zenith FTM-1490 with this batch of multiscanning monitors; it's well known that in order to provide a monitor with the circuitry required to enable it to scan at a variety of frequencies, manufacturers often must sacrifice picture quality. And considering the wide range of frequencies supported by the monitors reviewed here, they provide pretty good image quality. We think their inherent ability to move up to the next video standard makes them well worth considering.

In this issue we also look at asynchronous communications servers, high-end project management software, and desktop publishing training tapes.

–Kellyn S. Betts

Photographs: Thom O'Connor

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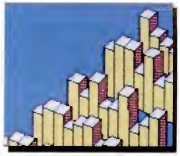


MULTISCANNING MONITOR

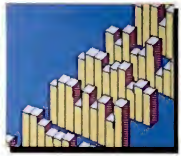
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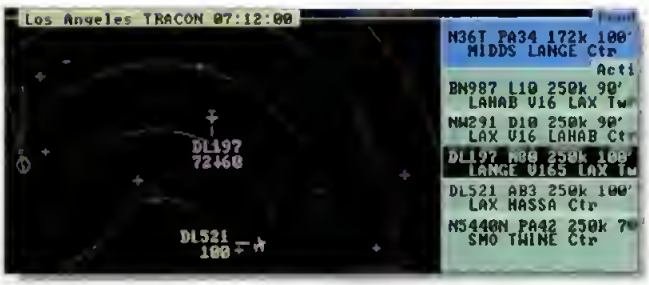
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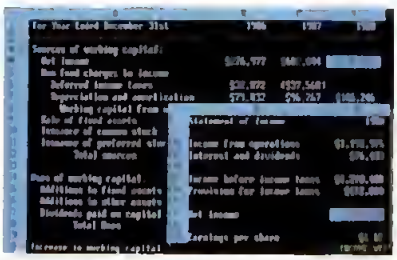
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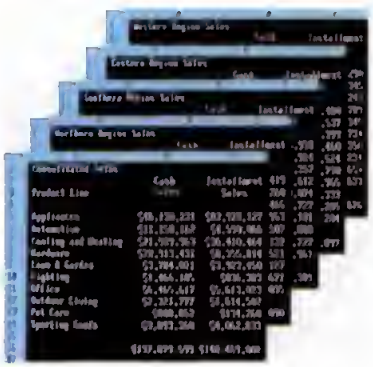
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PC MAGAZINE EDITOR'S CHOICE



PC MAGAZINE SAYS, JANUARY 31, 1989

"In short: Austin Computer Systems has a winning combination of classy parts, smart design, high performance, and aggressive pricing, all backed by a GE on-site service contract. How can you lose?"

Austin 286/12.5 Price Matrix

Choose Monitor Below	Choose Hard Drive Below	Price
EGA Color 640 x 350	40 MB HD (25 ms 1:1)	$2295
	80 MB HD (22 ms 1:1)	$2595
EEGA with Multi-freq Monitor 640 x 480	40 MB HD (25 ms 1:1)	$2495
	80 MB HD (22 ms 1:1)	$2795

Austin 286/12.5 Cache Standard Features:

- Intel 12.5 MHz 80286 Processor
- GE 1 Year On-Site Service Contract
- 14" EGA Color Monitor
- 16 Bit Paradise EEGA Autoswitch Display Adapter
- 40 MB-25 ms Super Fast Access Hard Drive
- 1:1 Fast Transfer Interleaving Controller Card
- 32K High Speed Hard Disk Cache
- Super PC Kwik Disk Caching Software
- 1 MB RAM (expands to 4 MB on board, 16 MB total)
- Shadow RAM Caching (BIOS Caching)
- EMS LIMM 4.0 Support
- American-Made MotherBoard
- 3.5" 1.44 or 5¼" 1.2 MB Floppy Disk Drive
- Phoenix BIOS
- Keytronics Enhanced 101 Keyboard
- 2 Serial Ports & 1 Parallel Port
- 1 PS/2 Mouse Port
- Clock with Battery Backup
- 80287 Math Co-Processor Socket
- FCC Class B Approved
- Users & Technical Reference Manual
- Built-in Setup & Diagnostics Program
- Fully DOS & OS/2 Compatible

AUSTIN 286/12 Comparison Chart

Features	Austin 286/12	Check Competition
GE 1 year on-site service	YES	
16 bit high speed display adapter	YES	
25 ms or faster hard drive	YES	
1:1 hard drive controller	YES	
Disk caching software (rated as #1 in industry)	YES	
32K hard drive cache	YES	
1 full MB of RAM	YES	
Shadow RAM	YES	
Surface mount construction	YES	
VLSI technology	YES	
I/O ports fully integrated	YES	
American-made motherboard	YES	

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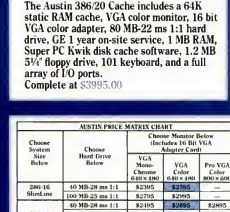
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	110 MB-17 ms ESDI	$3195	$3395	$3595
	150 MB-17 ms ESDI	$3395	$3595	$3795
	330 MB-28 ms 1:1	$3595	$3795	$3995
386/20 Cache	80 MB-22 ms 1:1	$3795	$3995	$4195
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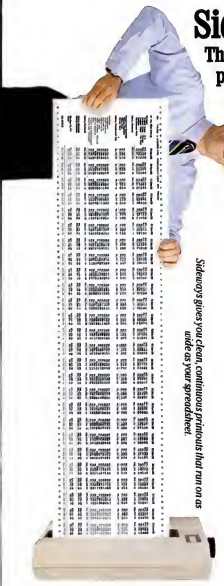
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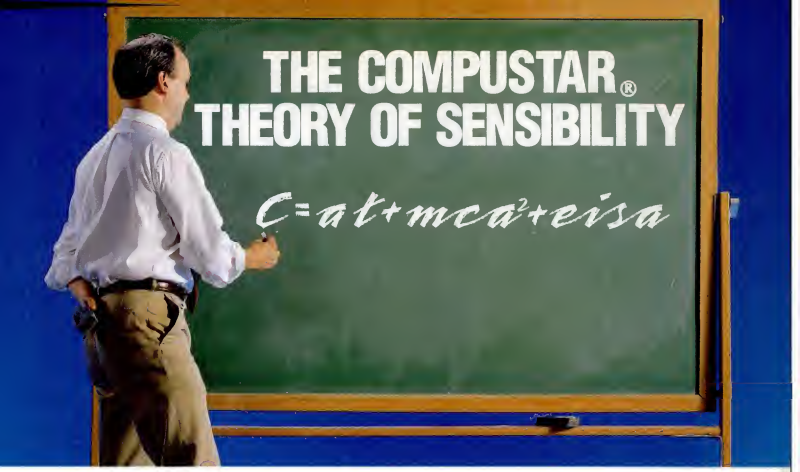
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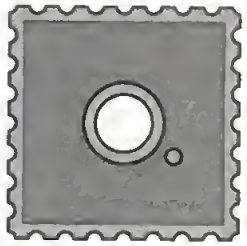
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LETTERS TO PC MAGAZINE



BIGGER REALLY IS BETTER

I enjoy *PC Magazine* and look forward to every issue. I know many people have complained that you keep waving a "bigger, better, faster hardware" flag. I think, however, that it is important to remember that you also keep publishing utilities, productivity tips, and so forth, to keep the existing hardware from growing barnacles.

Ken Baker
Eden Prairie, Minnesota

MEETING SCIENTISTS HALFWAY

I agree with Steven Arnold (Letters, *PC Magazine*, February 28, 1989) that "*PC Magazine* does not adequately cover the needs of the scientific/technical community." I bought *WordPerfect* 5.0 because of its great math/science fonts, but I can't see them on my EGA or print them on my dot matrix, and formatting equations is very difficult. We need your help and advice on scientific and technical applications!

Jack Foster
Scotts Valley, California

CHOOSE YOUR OS

I would like to see *PC Magazine* do some testing on the capabilities of the Unix/Xenix environment compared with networking and OS/2. As far as I have seen, the Unix/Xenix environment is the superior operating system. If you can show me something else that has the same capabilities and is cost-effective, I'd love to see it. If not, why don't you review some Unix/Xenix applications and show us more of what's available?

James Doolittle, Jr.
Utica, New York

PC Magazine seems to have become blinded recently to non–MS-DOS possibilities. Spreadsheets, word processors, and databases are very useful to many people. Admittedly, these and the myriad other programs make MS-DOS a very important operating system.

However, I run a veterinary clinic, and the only operating system I've been able to use effectively for my needs is Xenix. I, for one, have left the world of MS-DOS and would like to read more about alternative operating systems.

R. Scott Reeves
Newnan, Georgia

Thank you for a fine magazine and great utilities. I have used them for some time now and I find them to be invaluable. I am also glad to see that *PC Magazine* is finally turning the corner toward OS/2 and the Micro Channel. Keep up the good work!

Doug Carter
Portland, Oregon

THE MISSING PIECE

After reading your enthusiastic praise of the Zeos 25-MHz 386 machine ("25-MHz 386s: Fast, Expensive, and Worth It," *PC Magazine*, February 14, 1989), I feel bound to draw attention to a serious deficiency in these products. I found that there



is a complete lack of documentation for this machine.

I am very new to computers and was forced to figure out the hardware with no documentation or telephone support. As a service to your readers, your reviews should contain some reference to the adequacy of the documentation.

Paul Buisseret
Covington, Louisiana

PASSING IT ON

I would like to relate some information to Richard B. Naugle, the Eagle PC-Plus owner who is looking for software (Letters, *PC Magazine*, January 31, 1989). Contact Wilkinson Software at (714) 895-1759 for BIOS and other Eagle parts. Good luck!

Lloyd Corkan
Pittsburgh, Pennsylvania

BEYOND KERMIT

Jim Seymour may have his Muppets mixed up, but Lee Stevens (Letters, *PC Magazine*, February 28, 1989) can't spell his. "Ralph" the Dog, as any Muppet maven knows, is spelled "Rowl."

Chris Victor
Tulsa, Oklahoma

TEST-DRIVE A PC

Your response to the letter from Karen Lippe Brown of Iomega Corp. (Letters, *PC Magazine*, January 31, 1989) is the worst editorial comment I have ever read. You state, "In line with the PC Labs testing procedures, the benchmark-test figures for each removable mass-media system reflect that system's performance at its default settings."

It is most fortunate that you are not testing automobiles. It would be disconcerting to read a review in which you drove one car around the track in Reverse, one in Low, one in High, and then didn't test the



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■ LETTERS

other one because the "default" position when the car was left with you was Park.

Norman L. Donaldson
Granada Hills, California

In previous years, PC Magazine *editors have tested cars. To prolong the car analogy: default settings would be better equated to using shift points and techniques that won't destroy the drive train when testing acceleration and lap times. If you drop the clutch at 4,000 rpm from a standstill, you get dramatic 0–60 times and then the clutch fails. In the January 31 letter, Iomega wanted it both ways: for users to run the Bernoulli Box with verify on for reliability, and for PC Labs to test it with verify off for speed.*

By the way: most PCs we receive for review come with the power switch set to Off. That's the default setting in transit, but we do flip the big red switch to On before running benchmark tests.

COLUMNISTS ARE PEOPLE, TOO

John Dvorak continues to prove that he has a closed mind with but one thought: how to take a shot at IBM. He is boring and I am tired of him.

Now Stephen Manes has proved that he can't spell. He is no prodigy, and probably no prognosticator on the subject ("Prodigy: It Don't Get No Better Than This," *PC Magazine*, February 14, 1989).

Charles M. Horton
Southington, Connecticut

■ In a world of bugware, vaporware, and kludgemeister hardware companies mysteriously holding fast at $122 a share, Dvorak sets a standard for honesty.

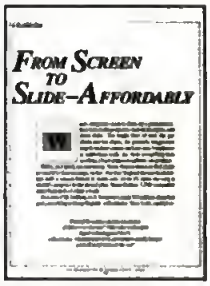
I admit that I usually find John Dvorak's Inside Track column of unjustifiable hyperbole about new technology to be a source of amusement. His unflinching belief in high-tech press releases is truly amazing, and the Chang modification affair was quite amusing to read about.

However, his column about a neural-network product (Inside Track, *PC Magazine*, January 17, 1989) did a great disservice to neural nets in particular and AI (artificial intelligence) in general. If someone wrote a program that could accurately predict the future in some area that would make them wealthy, why would they bother with selling the program? The objective of AI is not to do what a human mind is incapable of doing, but rather to approximate the human cognitive powers.

John Swan
Arlington, Virginia

A BETTER PICTURE

I greatly appreciated your recent article concerning the computer/slide-generation hardware ("From Screen to Slide—Affordably," *PC Magazine*, February 28, 1989). However, I wish you would have included samples of the slides that were generated by each of the machines. It definitely would have made individual comparisons much easier.



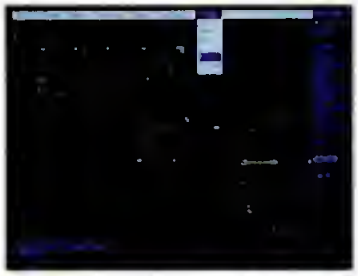
Gary Groeller
Redford, Indiana

SETTING A NEW STANDARD

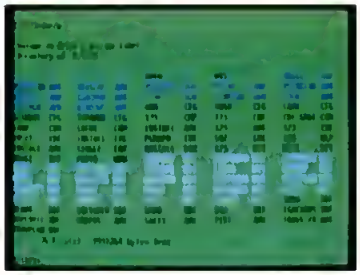
We have considered the technical issues mentioned in your review of our product *Critical Thinking I* (After Hours, *PC Magazine*, February 14, 1989) and are working on them. We agree that it should not be necessary to reboot on exit and are including instructions in our manuals demonstrating how to access DOS without rebooting.

We intend to replace the Finish command with a macro and are addressing the graphics problem.

E. O. G. Davies
President
Compris Inc.
Boston, Massachusetts



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Change fonts, colors and screen sizes in popular word processors like WordStar & Word Perfect. 80 × 60 shown.

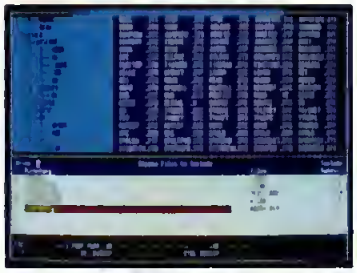




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UltraVision looks great on standard EGA monitors, and it gives you even more on autosync displays, like VGA-quality graphics and super high resolution character definition. Give your eyes a break. Your world will look a whole lot better.

UltraVision is from the makers of SeeMORE™, SmartNotes™, Look & Link™, and «BASE™. UltraVision for VGA and plasma displays coming soon.



These unretouched photos demonstrate how UltraVision improves character resolution on any EGA with autosync monitor. Normal EGA characters are defined in an 8 × 14 matrix versus 9 × 19 for UltraVision.

UltraVision

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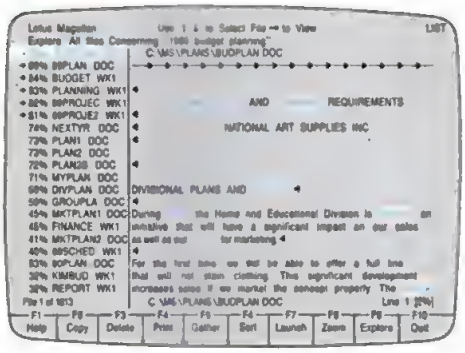
they appear in your favorite applications.

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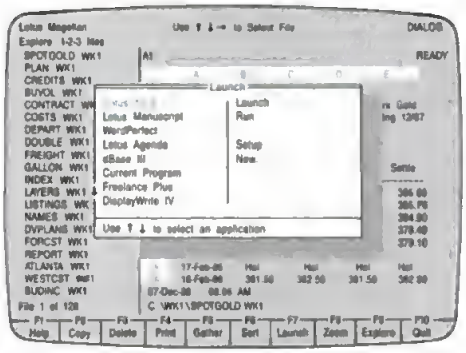
The Magellan Explore and SpeedView functions let you locate everything related to a particular topic and see it as it would appear in its native application.

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Or you could use Magellan to gather the information you choose from several different applications (like a 1-2-3® spreadsheet and a WordPerfect® memo)[1] and put it into a single file so you can start using it right away.

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Accountants get true multitasking via ACCPAC Plus and OS/2.

ACCPAC® Plus System Manager/2 is an accounting software package from Computer Associates International. It allows simultaneous execution of multiple accounting functions by using the protected mode of OS/2. This enables users to enter sales orders while concurrently performing payroll calculations and printing financial statements. In addition, thanks to the Virtual Memory Feature of OS/2, users can toggle between a number of applications without having to exit one program and load another. For additional information please call 1 800 531-5236.

Create exciting three-dimensional, dynamically developed maps using OS/2.

Mapmaking is easier than ever with MapViewer from Golden Software Inc. MapViewer uses OS/2 and Presentation Manager window screens to display two- and three-dimensional thematic maps. These maps can show population density or physical contours, and include shading. For additional information please call 1 303 279-1021.

Retailer begins use of OS/2 to monitor remote retail sales.

Host International has begun to use OS/2 to give computing capabilities to their individual concessions and to network shops with regional offices for daily downloading of sales and employee data. The internally developed system also provides for remote data entry, collection and reporting.



Developing graphics for OS/2 applications is made easy with Toolkit from Graphic Software Systems.

High-performance graphics on microcomputers are made possible with OS/2 Graphics Development Toolkit from Graphic Software Systems. This package supports all OS/2 features while maintaining source code compatibility with the DOS Graphics Development Toolkit. It allows dynamic loading plus workstation control. Functions for lines, arcs, polygons, circles, bars and advanced graphics are all part of the package. For additional information please call 1 503 644-6746.

Micrografx announces an easy way to port Windows applications to OS/2 Presentation Manager.

Micrografx® has introduced Micrografx Mirrors. This software development tool makes it easy to port any Microsoft Windows® application to the OS/2 Presentation Manager. It's currently being used successfully to port Micrografx Designer, Graph Plus, Draw Plus and Clip Art to OS/2. For additional information please call 1 800 272-3729.

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You can receive a 700-page OS/2 Application Guide that lists and describes over 800 identified applications for the OS/2 operating system. For a free copy of this guide call 1 800 IBM-2468, ext. 120.

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■ LETTERS

SOMETHING FOR EVERYONE

I read your magazine because of the level of writing: not too technical and not too simplistic. Lately, however, I find myself reading fewer and fewer of your articles, not because the writing style has changed, but because your definition of an end user seems to have changed. *PC Magazine* seems to think that the majority of your readers work in Fortune 500 companies with astronomical computer budgets and a laser printer on every desk.

Well, there are many of us who still have a PC-XT on our desks; please don't forget us. By all means, keep us up to date on the latest hot rod from Compaq, but don't forget that some of your readers drive Chevettes.

Lorne Cheeseman
Calgary, Alberta
Canada

Hurrah for letter writers Patrick Anderson and Norman Isaacson (Letters, *PC Magazine*, January 17, 1989). I agree that *PC Magazine* should pay attention to products that may be obsolete for business and other heavy use, but that are still more than adequate for home users.

Aren't there enough of us with modest needs to justify your devoting a little space to non-state-of-the-art but still very useful ideas?

Chester Sackett
Great Neck, New York

VOTES FOR DVORAK

John Dvorak is right on target with his assessment of Prodigy, the videotex service by IBM/Sears, which he labels "shallow" and "superficial" (Inside Track, *PC Magazine*, February 28, 1989).

Raul de Brigard
Higganum, Connecticut

Bravo, kudos, and all of that stuff to you, John Dvorak! I just finished reading your column ("My Dinner with IBM," *PC Magazine*, January 31, 1989). I laughed, I cried, I sold all my IBM stock.

In a world of vaporware, bugware, and kludgemeister hardware companies mysteriously holding fast at $122 a share, you set a standard for honesty.

Andrew Gemgross
Long Island City, New York

A CHANNEL'S TRUE PURPOSE

Channels communicate with outboard peripherals, and memory access is a part of the function of the CPU and the DAT-box, which performs Dynamic Address Translation ("Coprocessing: Who Needs It?" *PC Magazine*, March 14, 1989). A channel may move data to or from memory, but controlling it is not a channel's function.

Steven B. Olson
Bayonne, New Jersey

■ Keep us up to date on the latest hot rods from Compaq, but don't forget that some of your readers drive Chevettes.

LOOKING BACK, LOOKING AHEAD

Your end-of-the-year issue was great. The millennium has arrived: John Dvorak rightly labeled the AT bus an "old zombie" and *PC Magazine* recognized that the Micro Channel bus is a genuine technical advance—not a marketing ploy. I loved it!

Peter H. Strong
Los Angeles, California

A SMALL ERUPTION

Tony Lima's comment about the price of oil falling "like hot lava through a glacier" (Letters, *PC Magazine*, January 31, 1989) really had me seeing red. The fact that prices are temporarily down doesn't change the fact that oil remains very much "an increasingly scarce commodity in finite supply." A Ph.D. in economics isn't much to brag about if it doesn't enable you to figure that out.

Andrew T. Rowan
Trenton, New Jersey

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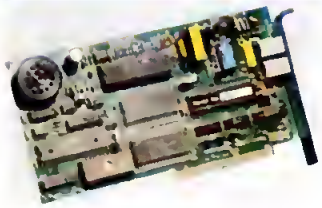
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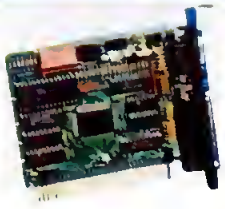
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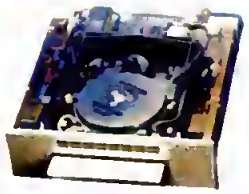


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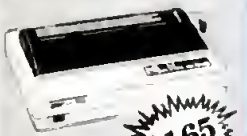
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OmniMouse $45
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Multi Res 6 ..... $199
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Sony 1303 ..... $449

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PC MAGAZINE EDITORS' CHOICE







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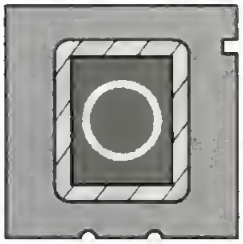
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■ LORI GRUNIN

PC ADVISOR



Suggestions for coaxing VGA performance out of your EGA, bringing 8086/8088 machines up to AT speed, and managing unstructured information.

SOFTWARE VGA

I use a frequency-scanning monitor with an EGA graphics board, and I've noticed that after running certain programs the text on my screen is noticeably sharper. How can I make the higher resolution permanent?

Ariston Malolos
New York, New York

UltraVision *($119.95; Personics, 63 Great Rd., Maynard, MA 01754; (508) 897-1519) can raise the resolution of most EGA cards to that of VGAs. The hardware-software combination consists of a small booster card that fits into the idle feature connector on your EGA card and software that lets you control colors, screen fonts, and screen size.*

Some EGA cards support extended screen modes; for those that don't, the booster card adds the capability. UltraVision *improves text resolution by increasing the EGA's 8- by 14-dot character matrix to 9 by 19. The high-resolution mode is maintained within all your applications, as well as at DOS level.*

As a bonus, a lot of graphics applications that check for VGA drivers will be fooled into thinking that you've got a VGA card, and your screen display will improve accordingly—in fact, many users choose UltraVision *as an inexpensive VGA alternative. Unfortunately, graphics programs that check for VGA hardware won't be conned.*

UltraVision *doesn't work with the PC's Limited EGA, Renaissance GRX Legacy, or Thomson EGA Ultra Version; if you've got one of these graphics adapters, you're out of luck. For a full accounting of* UltraVision*'s features and capabilities, see the review in First Looks on page 56 of the January 17, 1989, issue of* PC Magazine.

A POWER BOOST FOR YOUR XT

I need a realistic—read inexpensive—way to upgrade an 8086-based system to the level of an AT. Do you know of any turbo boards that will work in my machine? What do these cards really do?

Darcie Marvin
Sacramento, California

In answer to your first question, the most flexible turbo board on the market is the SOTA 286i ($499; SOTA Technology Inc., 657 N. Pastoria Ave., Sunnyvale, CA 94086; (408) 245-3366). The card will work in most 8086- and 8088-based machines—including the incompatibility-prone AT&T 6300. The card uses a 12.5-MHz 80286 processor and a 16K static RAM cache (expandable to 64K) to boost performance.

■ Installing a turbo board will speed up your machine and enable it to run most software that requires an 80286 chip.

Installing a turbo board will speed up your machine and enable it to run most software that requires an 80286 chip. It won't magically turn your machine—poof!—into an AT. For instance, unless you replace the motherboard, you're still stuck with your XT expansion slots. And an 8088-based machine will always have an 8-bit data bus, as opposed to the 80286's 16-bit bus.

The SOTA 286i is powerful enough, however, to let your computer approach AT-hood. An optional daughtercard with a floppy-disk controller ($149) adds serial and parallel ports, as well as the capability to support up to four drives, either high- or low-density. It also provides options to expand your memory and cache.

A review of the SOTA 286i appears in First Looks on page 43 of the February 28, 1989, issue of PC Magazine.

AFTER THE DELUGE

I am trying to grapple with the deluge of information that I face every day—journal articles, newspaper clippings, books. Would you know of software that can manage these references? It would be nice to use the impromptu database I started with my word processing software.

S. Mark Pereira
Céntreville, Virginia

There are several different routes you can take to manage the semistructured information you're talking about. PC Magazine

■ PC ADVISOR

covered information organizers in the December 13, 1988, issue ("Classified Intelligence: Managing Personal Information"). Of the products reviewed, three especially suit your needs.

All three packages let you create fielded records, as in a traditional database, or just enter information as you would with a word processor. They also let you perform full-text, complex Boolean searches.

They offer the flexibility you'll need if one day you want to, say, start adding pithy quotations to selected entries or perhaps incorporate your own writings into the textbase. In other words, with free-form databases you needn't worry in advance about the structure of your database.

Notebook II *($189; ProTem Software Inc., 814 Tolman Dr., Stanford, CA 94305; (800) 826-2222) is an organizer designed for keeping track of bibliographic information and research notes. Two optional modules allow you to import information from on-line citation databases* (Convert, *$99) and to construct a bibliography by comparing a manuscript to* Notebook II *entries* (Bibliography, *$75).*

■ With free-form databases you needn't worry in advance about the structure.

But if you need a package that will make text jump through hoops, then you either want askSam *($295; askSam Systems Inc., 119 S. Washington St., Perry, FL 32347; (800) 327-5726, (904) 584-6590), or* IZE *($445; Persoft Inc., 465 Science Dr., Madison, WI 53711; (608) 273-6000).*

With askSam, *you can import any ASCII file or enter text within the program and be up and querying in no time;* IZE *takes longer at first because you must assign at least one keyword to each record.*

askSam*'s only drawback is that for anything beyond simple queries the learning curve steepens dramatically—to customize output or store repetitive search formulae, you must create programs with* askSam*'s query language.* IZE, *on the other hand, is purely menu driven and, though not as powerful, is easier to customize.* Notebook II *has relatively stringent format requirements for text importation.*

ASK THE ADVISOR

Send your questions to PC Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the Utilities column for access information). Please specify your equipment. PC

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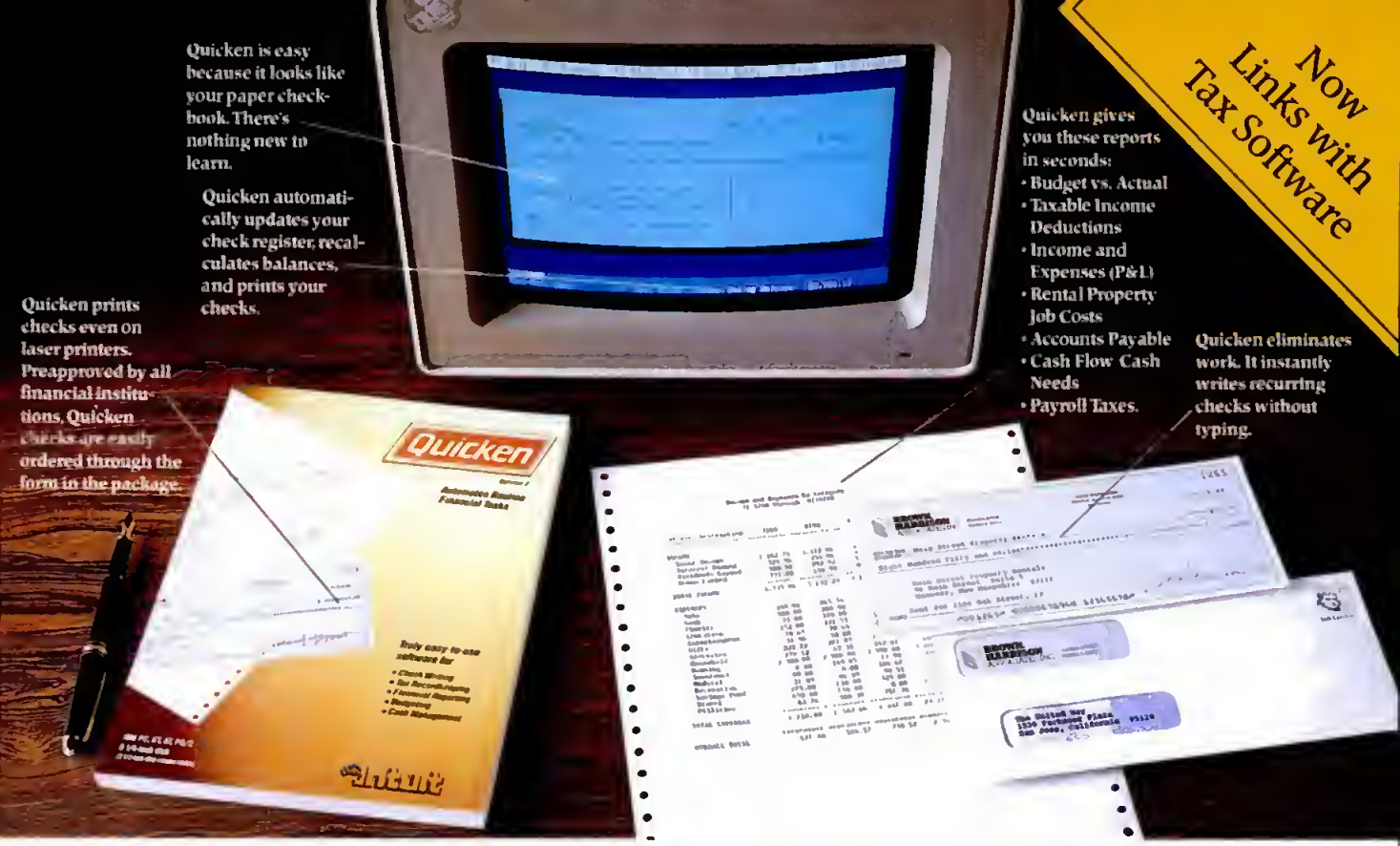
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Bill Howard
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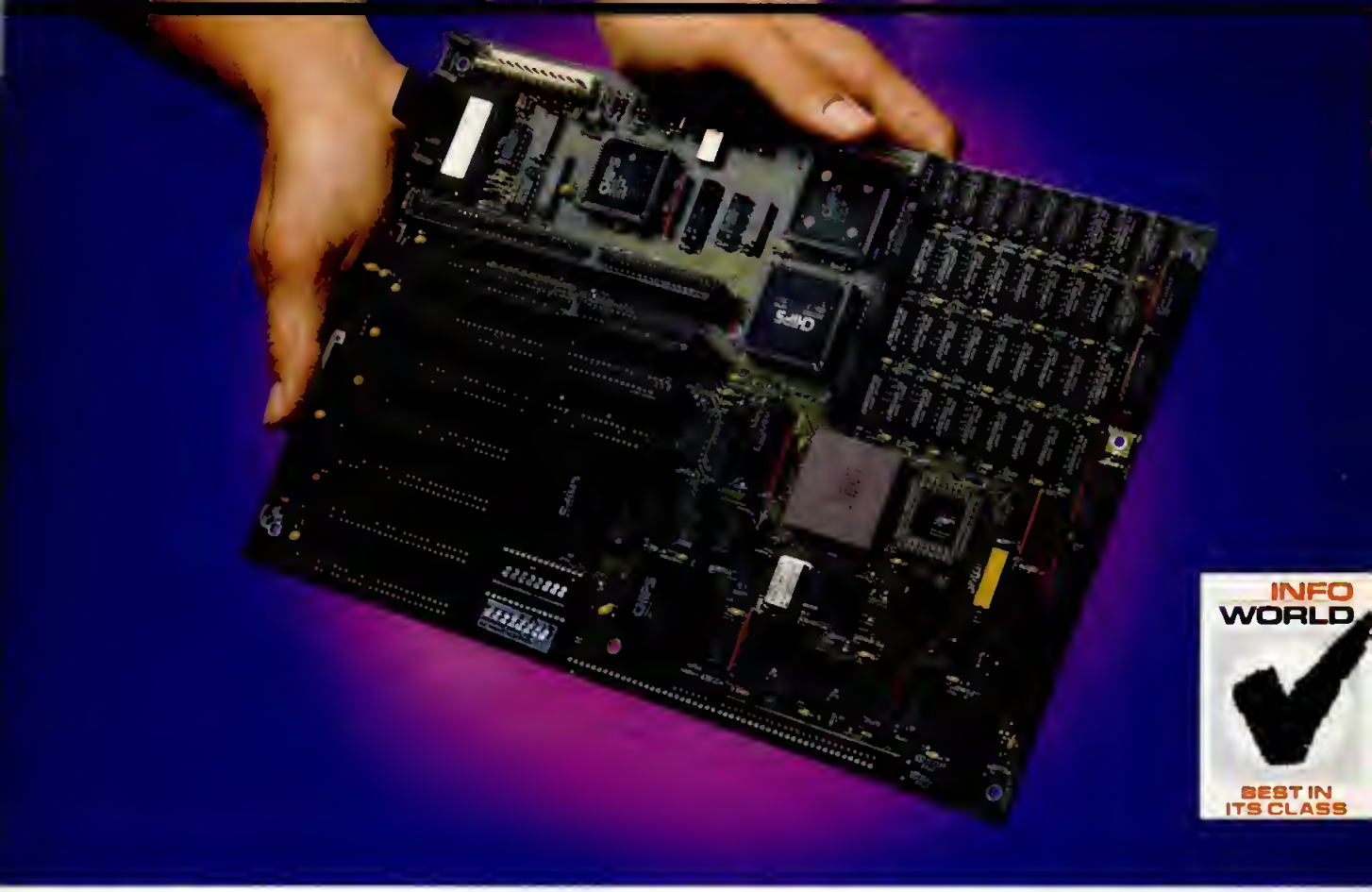
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PC MAGAZINE

FIRST LOOKS

Impress Coaxes Presentation-Quality Output from Lotus 1-2-3

PC HANDS ON

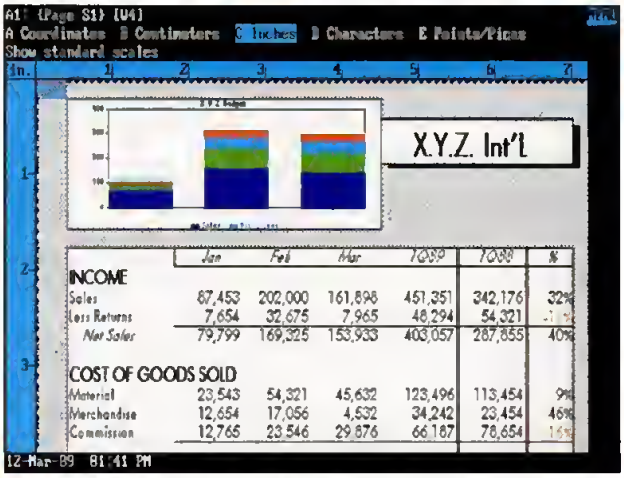
BY CRAIG STINSON

The day of the ugly spreadsheet report is surely dead. *Lotus 1-2-3* users who'd rather add-in than switch now have two powerful publishing programs to choose from: Funk Software's *Allways* (see First Looks, *PC Magazine*, January 31, 1989) and *Impress*, a newcomer from PC Publishing. *Impress* looks like a worthy competitor: with only a few foibles, it matches almost all the functionality of *Allways* and adds a good deal of its own.

Like *Allways*, *Impress* is designed to generate boardroom-quality output directly from your *1-2-3*, Release 2, worksheet. The product offers typeface and size selection on a cell-by-cell basis, as well as boldface, italics, underlining, boxes, rules, shading, and a host of printer setup conveniences. You can also mix text and graphics on the same page without having to summon PrintGraph.

And, like *Allways*, *Impress* has received a strong endorsement from its principal beneficiary, Lotus Development Corp. For an unspecified period of time, Lotus is bundling *Im-*

(continues on next page)



Unlike Allways, Impress *can embed "live" graphs into a worksheet. Worksheet borders can indicate print dimensions rather than cell coordinates.*

HP DeskJet Plus: A Faster, More Powerful DeskJet, Still $995

PC HANDS ON

BY JONATHAN MATZKIN

Hewlett-Packard's DeskJet turned quite a few heads. It was one of the first ink jet printers to deliver the crisp text output and high-density graphics that critical business and desktop publishing applications demand. Perhaps best of all, it did these things while taking up hardly any desk space and making hardly any noise—all at a list price of $995.

Now, Hewlett-Packard is making a good thing better with the introduction of its DeskJet Plus. The HP DeskJet Plus tackles some of the problems of the original DeskJet, namely slow performance and lack of internal fonts. And it does so at the same $995 list price its older sibling commanded.

The original DeskJet? HP will continue selling it, but at a lower price of $795. Prices for the DeskJet's accessory fonts have also been dropped by 30 percent.

One immediately noticeable improvement in the DeskJet Plus lies within the algorithms used to compute proportional spacing. Proportionally spaced fonts are still optional; you have to buy font cartridges to get them. That quibble aside, the DeskJet Plus does much better with proportional spacing than its predecessor does. The proportionally spaced Times Roman font looks much more like typeset print than the older DeskJet's equivalent output.

While the DeskJet Plus still offers only one native typeface—a good-looking Courier—it is now available in ten fonts. Six of these are portrait fonts, and four of them have the landscape orientation necessary for easy spreadsheet printing. The DeskJet Plus no longer needs an upgrade cartridge to accomplish this feat.

Optional fonts of up to 30-point size are now available for the DeskJet Plus in both cartridge and soft-font formats. Unfortunately, while most fonts from the original machine are upwardly compatible, the Desk-

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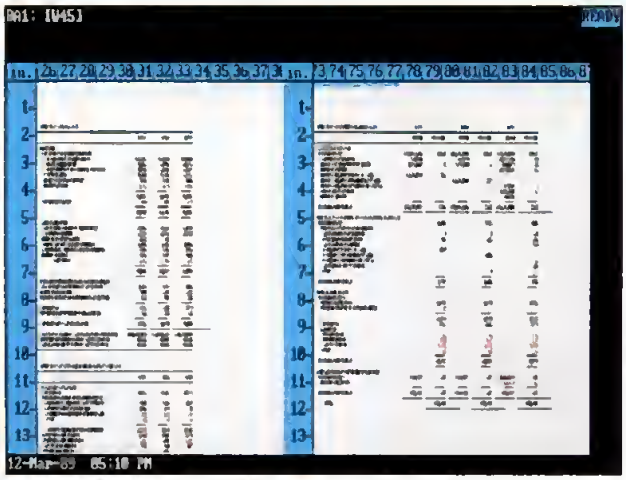
Impress

(continued from page 33)

press with new copies of Release 2.01 sold in Europe and Australia. Lotus struck the same deal with the folks behind *Allways* for *1-2-3* shipments in the U.S.

Allways figures to whip *Impress* in the U.S. by virtue of the bundling agreement and its long-standing reputation as a spreadsheet accessory maker. But if you're looking to add publishing prowess to your existing copies of *1-2-3*, you'd do well to check out *Impress*.

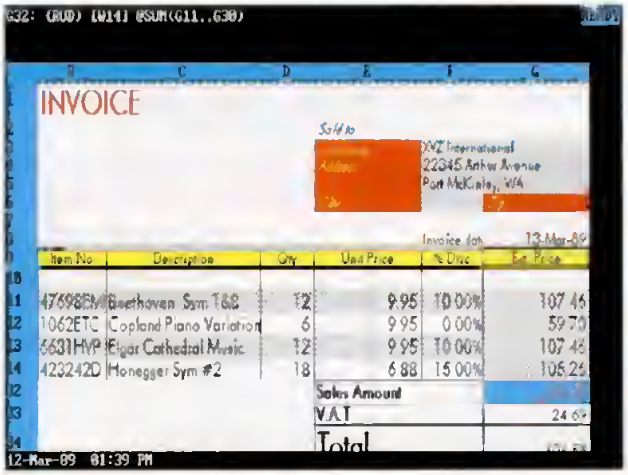
Impress lets you build and edit your spreadsheet in either the normal *1-2-3* display mode or in "enhanced" (that is, graphics) mode. Every feature of both *1-2-3* and the add-in is available at all times, in either mode. With *Allways*, you have to toggle back and forth between *1-2-3* mode, where you edit your worksheet, and *Allways* mode, where you specify fonts, shadings, and so forth. *Impress*'s approach makes it much easier to design a worksheet from the ground up with presentation attributes in mind.



Impress's print-preview feature gives you a panoramic view of your work.

Both programs can integrate frozen graphs (.PIC files) into a spreadsheet printout. But *Impress* can incorporate "live" graphs as well. In other words, you can set up embedded graphs so that they automatically reflect changes in your worksheet. In *Allways*, you have to regenerate the .PIC file each time you change the data.

Both programs offer a host of page-layout and printer-setup conveniences, allowing you to do such things as choose between portrait and landscape mode without reaching for your printer manual. Both programs will show you all your current page layout and printer settings on an easy-to-read status screen, and both programs support color printers (and let you change color attributes on a cell-by-cell basis).



Impress lets you enter and edit data in either the normal 1-2-3 *view or the WYSIWYG,* Impress *view. All features of both programs are active in each view.*

Memory consumption is comparable. *Impress*, at 100K RAM, is a bit thriftier than *Allways* at 128K. But if that small difference is a concern, you probably need expanded memory anyway, which both programs support.

Impress includes several features that should especially appeal to those with strict copy-fitting requirements. First, *Impress* lets you change the border display to show printed dimensions—in centimeters, inches, fixed-pitch characters, or picas—instead of column and row position. This means you can determine at a glance exactly where on the page each portion of the worksheet will print.

If you simply need to fit a given amount of worksheet into a given amount of space, you'll want to make use of *Impress*'s scaling commands. Both on screen and on paper, you can size your output up or down by any percentage you choose—from 25 to 200 percent on screen, and from 15 to 1,000 percent on paper. To save you the hassle of computing scaling factors, moreover, *Impress* includes a command to automatically fit your print range, however large it may be, onto a single sheet of paper.

A fill-screen print-preview facility, which makes it easy to assess the relative weight of white and nonwhite space, is another convenience *Allways* left out. And in case you want your output to look a little more like *Microsoft Excel*'s, you can have your printouts include worksheet grid lines and/or cell coordinates.

Font options in *Impress* are a little more extensive than in *Allways*. Both add-ins let you keep eight fonts active at any time—chosen from a wider set of serif, sans serif, and Courier fonts. Both programs support the full range of HP cartridges and all the internal PostScript fonts. Both download font data when the desired font is not available in hardware, and both use graphics mode on dot matrix printers when downloading is not possible.

But *Impress* offers a Symbol font not available in *Allways*. And the point-size range in *Impress* is 3 to 24, compared with *Allways*'s 5 to 24.

So much for good news. Like most other new software, *Impress* has its shortcomings, oversights, and at least one bug.

Two serious shortcomings have to do with documentation and the adjustment of column widths and row heights. Much of *Impress*'s rather lean manual reads like an engineering report from someone whose native tongue is not English. PC Publishing, unfortunately, seems to have lacked the good sense to hire a translator.

As for the setting of widths and heights, the program is neither slick nor flexible. You can't manipulate rows and columns with the cursor keys (even *1-2-3* is more advanced than *Impress* in this regard), and you're limited to whole-character increments for column widths.

In the oversight department, *Impress* failed to make an obvious—and necessary—improvement to *1-2-3*'s handling of centered text. In *1-2-3*, a cen-

FACT FILE

Impress
PC Publishing Inc.
1801 Avenue of the Stars
Los Angeles, CA 90067
(213) 556-3630
List Price: $139
Requires: *Lotus 1-2-3*, Release 2 or 2.01; 100K above normal worksheet needs; graphics display; graphics printer; DOS 2.0 or later.
In Short: A *Lotus 1-2-3* add-in that provides powerful WYSIWYG publishing support and lets you work with the spreadsheet in graphics or text mode. Not copy protected.

CIRCLE **452** ON READER SERVICE CARD

tered label that's too wide for its column spills over into adjacent columns on the right side only. That's tolerable (though not great) in a program that uses characters of fixed size, but it just doesn't work for presentation purposes. It makes the centering of heads a frustrating trial-and-error process, and it's one that has to be repeated every time the text of the head is changed.

Finally, one mildly irritating bug emerged in tests for this review. When a worksheet made up largely of Helvetica text was reduced in size by a third for printing purposes, the Helvetica mysteriously turned into Times.

All debate over which is the better worksheet-publishing add-in may become irrelevant if Release 3.0 of *1-2-3* includes built-in fancy-printing support, as rumored. It's unlikely that any font support Lotus does include will come close to matching the functionality of *Allways* or *Impress*.

Which is better? As with most software, the answer depends to a great extent on individual taste. In a feature-to-feature comparison, however, *Impress* is the clear winner. It boasts nearly every additional feature I wished for when I reviewed *Allways*, including live graphs, full-screen print preview, and the ability to edit in graphics mode. Its only serious failing lies in its handling of centered text.

HP DeskJet Plus

(continued from page 33)

Jet Plus font cartridges can't be used on the older machine.

Print speed has been beefed up considerably in the DeskJet Plus, thanks to a faster processor, bidirectional graphics printing, and improvements in the paper-feed mechanism. The changes do little, if anything, to speed printing of straight text, but you'll immediately notice the difference once you begin to print graphics.

I constructed a simple *WordPerfect* 5.0 document that mixed text with a graphic roughly one-quarter page in size. The original DeskJet slogged through the page in 2 minutes and 40 seconds. The DeskJet Plus ate up the same print job in a mere 49 seconds. This doesn't include the time necessary for downloading the page; the printers were timed from the moment they loaded the page until it dropped into the output tray.

Some of the DeskJet Plus's greatest strengths are what HP chose *not* to mess with. The printer is clearly aimed at applications in which size and noise are not considered virtues. Since the DeskJet Plus retains the svelte 8- by 17.3- by 14.8-inch (HWD) dimensions of its predecessor, it fits neatly into tight office spaces. The front loading cut-sheet paper tray relieves the annoyance of having to leave space around a dot matrix unit to allow for an unimpeded flow of fanfold paper.

And if noise is a particular problem, as it can be in legal or medical offices or libraries, the HP DeskJet (as well as the Plus) is a natural. Its whisper-quiet operation is a stark contrast to the clattering racket generated by most impact PC printers.

The DeskJet Plus carries some of the same liabilities as the DeskJet, however. The print can still be easily smeared by a wet finger, you'll still have to buy separate cartridges if you want IBM or Epson emulation, and printing still isn't speedy—at least by laser standards.

For the budget-conscious user with very high standards for print quality and graphics capability, though, the HP DeskJet Plus is hard to beat. If you can afford a laser, a laser is what you should buy. But if you demand near-laser quality output and a variety of available fonts at a lower price, the DeskJet Plus should definitely be a top consideration.



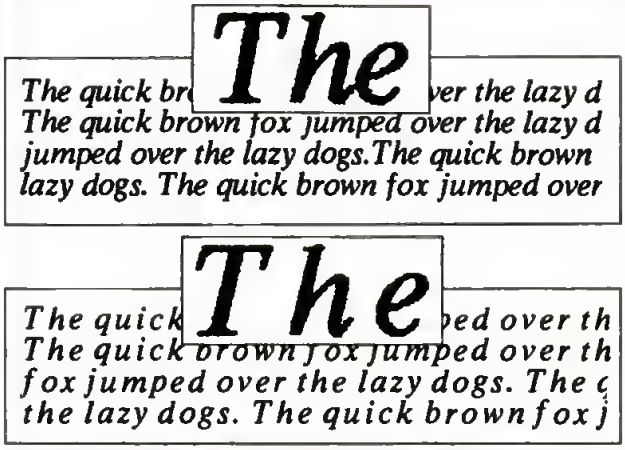
HP's DeskJet Plus looks virtually identical to the original DeskJet, but adds a number of enhancements, including higher graphics print speed.

Photograph: Thom O'Connor

FACT FILE

HP DeskJet Plus
Hewlett-Packard Co.
Inquiries
19310 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
List Price: $995
In Short: The HP DeskJet Plus improves performance with additional fonts and better speed; while maintaining the DeskJet's original price tag.

CIRCLE 450 ON READER SERVICE CARD



The DeskJet Plus (top sample) does a much better job of printing proportionally spaced type than the DeskJet. Plus font cartridges are not downwardly compatible.

HP DeskJet Plus

```
I went to the woods because I
wished to live deliberately,
to front only the essential
facts of life. - H. D. Thoreau
Courier Bold Underline Compresse
Courier Bold Underline Compresse
Courier Bold Underline Compresse
```

Type: Ink jet
Carriage width: 9 ½ in.
Price: $995

SPEED (cps):
Rated: 120
Default: 62

TYPE PITCHES (cpi): 5, 10, 16.67, 20 (others optional)

SOUND LEVEL (decibels):
Tested: <60

FEATURES:
Printing: Bold, correspondence quality, sub/superscript, underline
Formatting: Centered, double high, horizontal tabs, vertical tabs, justified, proportional spacing (optional), variable form length, variable line height

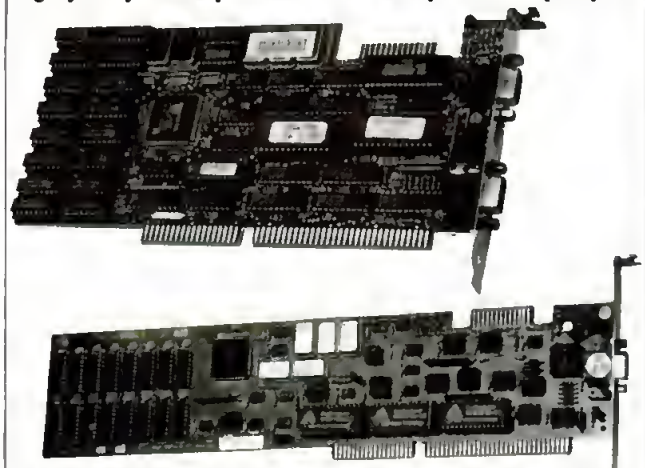
COMPATIBILITY:
IBM character set: Low and high
Graphics: Optional Epson graphics
Text: HP LaserJet, optional Epson text

16-Bit Extended VGA: Orchid for Speed, STB for Digital Display Compatibility

PC HANDS ON

BY WINN L. ROSCH

Getting the most out of your investment in a multiscanning monitor requires more than just an ordinary display adapter. Only the best have resolution sharp enough, spectra wide enough, and speed fast enough to make a real difference. The latest adapters from Orchid Technology and STB Systems will push your multiscanning monitor to its limits—and delight your eyes in the process.



The STB VGA EM-16 and the full-length Orchid ProDesigner Plus VGA each offer 16 colors at a peak resolution of 1,024 lines. The STB drives digital and analog monitors.

In many ways the ProDesigner Plus VGA from Orchid and the VGA EM-16 from STB are twins. They're built from the same Tseng Labs VLSI chip. In addition, both boards double maximum VGA memory by accommodating as much as 512K of memory, though cost-conscious buyers may opt for the lower-priced versions with half the RAM.

Both boards make enough pixels to strain all but the best multiscanning displays—noninterlaced 1,024 by 768 pixels—and both hedge their bets at that resolution level by backing the interlaced display standard set by IBM's 8514. Neither board, however, incorporates the Application Interface of IBM's 8514/A display adapter, nor do they claim any other degree of 8514/A compatibility.

The primary benefit of the bigger memories of these boards is a wider spectrum. Both Orchid and STB add more hues at the VGA's 640 by 480 graphics resolution—256 colors selected from a palette of 262,144. And, with full RAM endowment, each of these boards can display 16 colors at the 1,024-line resolution. Both support a multitude of intermediate resolutions, as well.

Of course, to take advantage of the beyond-VGA quality either of these boards offers, you'll need special drivers. Both boards include high-resolution drivers for *WordPerfect; Lotus 1-2-3*, Release 2; *Symphony; Microsoft Windows*, Version 2.0 (only STB currently supports *Windows/386*); *GEM; Ventura Publisher; AutoCAD;* and other programs. Neither includes OS/2 drivers.

With software written solely for IBM video standards, however, both boards cover all the bases. Both deliver full compatibility with any IBM display standard all the way back to the MDA. Both also back Hercules graphics. However, the STB board puts Hercules graphics on the monitor it was meant for; the Orchid product interpolates them for VGA displays.

One look will tell you these are fraternal, not identical, twins. The Orchid display hardware matches the pattern set by IBM's PS/2 Display Adapter, a long, narrow board only 4 inches high and a full 13-inch slot long. STB follows a more-traditional design approach in a standard two-thirds-length board design.

Both boards are able to automatically adapt to either 8- or 16-bit expansion buses, though they can be manually locked into compatibility with either bus width. While both provide a VGA-style feature connector for future expansion possibilities, as well as a high-density 15-pin D-shell output for analog displays, STB also includes a 9-pin D-shell for digital monitors.

Still deeper than mere appearances, the differences between these twins are inherent in their respective philosophies. Orchid's ProDesigner Plus VGA never looks back, at least as far as older IBM displays are concerned. It works with only VGA and multiscanning display adapters. STB, on the other hand, lets you gradually upgrade your system display. It will drive monochrome, CGA, and EGA displays in addition to VGA and multiscanning sets. On the other hand, the ProDesigner Plus VGA gives you less to worry about—fewer switches and jumpers—in setting up.

The twins also differ in their degrees of register-level VGA compatibility. While Orchid misses the mark when it comes to manipulating registers, the STB slips when it tries to use certain video modes. For instance, it failed to adjust the screen to the correct height when displaying 350-line EGA graphics on an analog monitor. Both boards jitter somewhat when confronted with diagonal scrolling. In other words, neither is as close to perfect compatibility as are the best of today's VGA adapters.

In the display-speed sprints, Orchid's ProDesigner Plus VGA beat the STB in every heat. The Orchid is about twice as fast in BIOS-mediated screen writing and 50 percent faster on direct screen writes. In fact, the difference in speed was so great during testing that I suspected the STB was operating in 8-bit mode, but when I switched the STB to its actual 8-bit mode, its display times doubled again.

The speed difference is less obvious once you've invoked the speed-up utility that accompanies each board. The utility copies the BIOS-extension code from the adapter's on-board ROM to faster system RAM, in effect giving ROM shadowing abilities (at least for video routines) to systems that lack them.

Both boards function well for the most part, and both offer enough beyond-VGA modes to get the most from your multiscanning monitor, but each boasts its own strengths. If pure speed is what you need, go with Orchid's ProDesigner Plus VGA. If you plan to keep your monochrome, CGA, or EGA monitor around for a while, STB's VGA EM-16 is the only choice. PC

PC MAGAZINE FACT FILE

VGA EM-16
STB Systems Inc.
1651 N. Glenville, #210
Richardson, TX 75081
(214) 234-8750
List Price: With 256K, $449; with 512K, $649.
Requires: XT, AT, or compatible with open slot; monochrome, CGA, EGA, VGA, or multiscanning monitor.

CIRCLE 448 ON READER SERVICE CARD

ProDesigner Plus VGA
Orchid Technology
45365 Northport Loop West
Fremont, CA 94538
(415) 683-0300
List Price: With 256K, $499; with 512K, $599.
Requires: XT, AT, or compatible with open slot; VGA or analog multiscanning monitor.

CIRCLE 449 ON READER SERVICE CARD

New Glyphix LaserJet fonts for Word & WordPerfect.

Glyphix 3.0 Sets A New Performance Standard.

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Garamand
Baskerton
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Century

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Oxford
Eterna
Classic Typewriter
New York Deco

SANS SERIF FONT SET
Avant Guard
Gibraltar
Bongo Black
Obelisk

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Manuscript
Buckingham
Copperfield

FIXED FONT SET
Courier
Prestige
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Technical Requirements: Glyphix fonts require an IBM PC, AT, XT, PS/2 or compatible with 512Kb RAM, hard disk, HP LaserJet Series II (512K), LaserJet Plus (384K) or compatible printer, MS-DOS 2.0 or later. Font Installation Kits are required for Microsoft Word 5.0 and WordPerfect 5.0

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CIRCLE 299 ON READER SERVICE CARD

Panasonic Redefines Dot Matrix Low End, Again

PC HANDS ON

BY JONATHAN MATZKIN

I still haven't bought the idea of trickle-down economics, but Panasonic's new dot-matrix printers are making me a believer in "trickle-down" technology. These low-end 9-pin machines boast a laundry list of features you would expect to find in high-end printers. They also deliver solid performance at prices that should make the competition swallow hard.

The KX-P1191 and KX-P1180 are very much in the same spirit as the recently introduced KX-P1124, Panasonic's low-end 24-pin offering. With performance and features like these, dot matrix printers—particularly those at the low end—may be around longer than laser fanatics predict.

The $399.95 KX-P1191 shoehorns an excellent array of features into its compact case. Its 5¼- by 5½- by 12½-inch (HWD) dimensions are close to those of its predecessor, the KX-P1091i, but the resemblance ends with size. The KX-P1191 sports a front-mounted control panel that is an adaptation of the one found on the 24-pin KX-P1124.



Panasonic's versatile new KX-P1191 offers paper parking and multiple internal fonts, and has a very compact case.

Many of the KX-P1191's most important features, including typefaces, font sizes, and margins can be easily adjusted from this control panel. The row-and-column layout of the panel isn't as easy to decipher as it seems at first glance, but using it becomes second nature with a little practice.

Panasonic has given its new generation of low-end machines much-improved paper handling to go along with their ease of use. Most notably, the KX-P1191 has a bottom slot that allows you the option of loading fanfold paper from underneath. It also has paper parking, a feature found on only expensive printers not so long ago.

Panasonic's previous low-end dot-matrix machines set new standards for the print quality you could reasonably expect from inexpensive printers, and the new machines uphold those standards. The KX-P1191 has four built-in typefaces, three of which can be conveniently selected from the front panel.

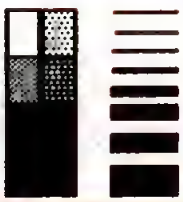
The Courier typeface in NLQ (near-letter-quality) mode looks good enough for internal memos and the like, though you probably would want a 24-pin or laser printer for more-important reports and correspondence. The other typefaces, especially the sans serif, are solid and well formed. There are limits on the print quality that 9-pin technology can produce, especially at the low end, but the KX-P1191 generates consistently good-looking output.

At around 100 characters per second in draft mode and 31 cps in NLQ mode, the KX-P1191 is not the fastest dot-matrix printer around, but it is certainly faster than many units in its price range.

For those on a very limited budget, the $299.95 KX-P1180 offers many of the features of the KX-P1191. It, too, accepts fanfold paper from below as well as behind, and it sports a simplified version of the same control panel. The modest price also buys you paper parking and the same four built-in fonts that the KX-P1191 has. The KX-P1180's draft mode speed is a bit slower (91 cps) but still acceptable for most personal and small-business applications.

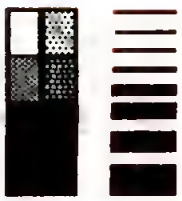
For personal use in applications in which near-typeset print quality isn't required, the Panasonic KX-P1191 and the KX-P1180 are excellent choices. Students, in particular, will find them to be a good combination of compactness, performance, and value. PC

Panasonic KX-P1180



I went to the woods be
wished to live deliber
to front only the esse
facts of life. - H. D.
Pica Bold Underline Co
NLQ Pica Bold Underlin
Bold PS Bold Underline

Panasonic KX-P1191



I went to the woods be
wished to live deliber
to front only the esse
facts of life. - H. D.
Pica Bold Underline Co
NLQ Pica Bold Underlin
Bold PS Bold Underline

Type: 9-pin impact matrix
Carriage width: 9 ⅜ in.
Price: KX-P1180: $299.95; KX-P1191: $399.95

SPEED (cps):
Rated: KX-P1180: 160; KX-P1191: 200
Default: KX-P1180: 91; KX-P1191: 101

TYPE PITCHES (cpi): 5, 6, 7.5, 8.5, 10, 12, 15, 17, 20

SOUND LEVEL (decibels):
Tested: 80

FEATURES:
Printing: Bold, double strike, correspondence quality, sub/superscript, underline
Formatting: Centered, double high, double width, horizontal tabs, vertical tabs, justified, proportional spacing, variable form length, variable line height

COMPATIBILITY:
IBM character set: Low and high
Graphics: Epson FX-86e/FX 800, IBM Proprinter II
Text: Epson FX 86e/FX 800, IBM Proprinter II

PC MAGAZINE FACT FILE

Panasonic KX-P1191
Panasonic KX-P1180
Panasonic Industrial Co.
Computer Products Division
2 Panasonic Way
Secaucus, NJ 07094
(800) PIC-8086
List Price: Panasonic KX-P1191, $399.95; KX-Pt180, $299.95.
In Short: Solid 9-pin dot-matrix performers with the features and print quality of higher-priced models.

CIRCLE 444 ON READER SERVICE CARD

C>ERASE *.*
Are you sure (Y/N)?_

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NOW SUPPORTS DOS 4.0!

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Best of all, Data Guardian makes file recovery quick, easy and totally foolproof. Without the complexity of other data recovery software. And without the uncertainty. Thanks to Data Guardian, Disk Optimizer comes through for you every time.

You formatted what drive?

That's fine for erased files, you say. But what happens if you accidentally format your hard disk? No problem. Disk Optimizer comes through again with *UnFormat* that can instantly restore all the data on your disk to exactly where it was before that little slip of the finger on the keyboard.

And to make sure your data is really safe, the *TrackSaver* feature protects the surface of your disk from excessive wear by preventing the head on your drive from spinning over the same track for too long. And the *Refresh* program prevents the bad spots that develop on disks due to fading magnetic charges.

Still the safest buy in performance optimizers.

As always, Disk Optimizer also gives you the safest, most advanced performance optimization available—proven by over a quarter of a million users.

The *Optimize* program speeds up disk reading and writing times by up to 300 percent by un-doing the file fragmentation that takes place naturally over time. And now, all sizes of hard disks can be protected! Disk Optimizer 4.0 fully supports DOS 4.0, so that even high capacity drives can be safe and reliable. If your applications require a hard disk of more than 30 MB, Disk Optimizer 4.0 is for you.



A total of 17 different programs.

Disk Optimizer includes *Findfile* for locating files by name or wildcard anywhere on your disk. *Sorts* for rearranging files and directories in the way that makes sense to you. *Lock* and *Unlock* for password-protected file security. *Killfile* for erasing sensitive data permanently. And lots more.

In all, there are 17 different programs in the new Disk Optimizer. Each one designed to improve performance, guard your data, and make disk management easier and simpler for everyone.

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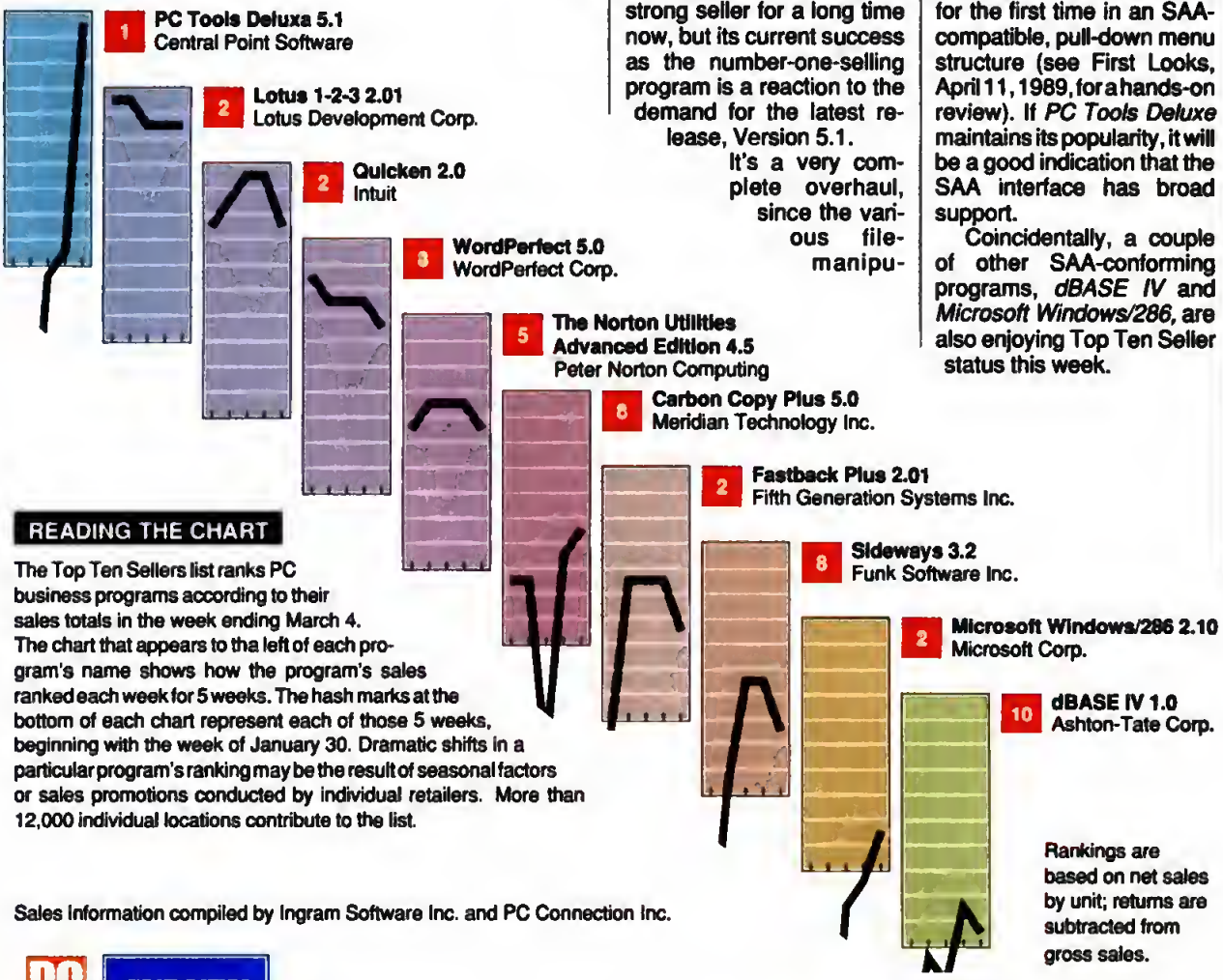
SOFTLOGIC SOLUTIONS

#6

CIRCLE 334 ON READER SERVICE CARD

PC MAGAZINE PIPELINE

TOP TEN SELLERS — A 5-Week History



1 **PC Tools Deluxe 5.1**
Central Point Software

2 **Lotus 1-2-3 2.01**
Lotus Development Corp.

2 **Quicken 2.0**
Intuit

3 **WordPerfect 5.0**
WordPerfect Corp.

5 **The Norton Utilities Advanced Edition 4.5**
Peter Norton Computing

6 **Carbon Copy Plus 5.0**
Meridian Technology Inc.

2 **Fastback Plus 2.01**
Fifth Generation Systems Inc.

8 **Sideways 3.2**
Funk Software Inc.

2 **Microsoft Windows/286 2.10**
Microsoft Corp.

10 **dBASE IV 1.0**
Ashton-Tate Corp.

PC Tools Deluxe has been a strong seller for a long time now, but its current success as the number-one-selling program is a reaction to the demand for the latest release, Version 5.1.

It's a very complete overhaul, since the various file-manipulation utilities are integrated for the first time in an SAA-compatible, pull-down menu structure (see First Looks, April 11, 1989, for a hands-on review). If *PC Tools Deluxe* maintains its popularity, it will be a good indication that the SAA interface has broad support.

Coincidentally, a couple of other SAA-conforming programs, *dBASE IV* and *Microsoft Windows/286*, are also enjoying Top Ten Seller status this week.

READING THE CHART

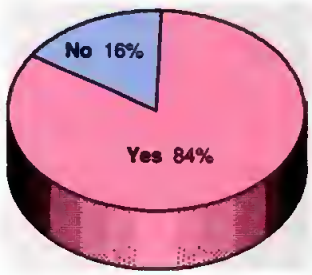
The Top Ten Sellers list ranks PC business programs according to their sales totals in the week ending March 4. The chart that appears to tha left of each program's name shows how the program's sales ranked each week for 5 weeks. The hash marks at the bottom of each chart represent each of those 5 weeks, beginning with the week of January 30. Dramatic shifts in a particular program's ranking may be the result of seasonal factors or sales promotions conducted by individual retailers. More than 12,000 individual locations contribute to the list.

Rankings are based on net sales by unit; returns are subtracted from gross sales.

Sales Information compiled by Ingram Software Inc. and PC Connection Inc.

PC MagNet SURVEY

Do you personally use a LAN?



Novell and 3Com are right to be concerned about how a LAN operating system works with Unix and the various SQL database servers on the market. When we polled callers to PC MagNet, they rated connectability a strong factor in choosing a network, right after the more basic questions of reliability and performance.

Curiously, technical support wasn't rated a high factor in choosing a LAN. Perhaps that's because most companies maintain a full-time network administrator, but it sounds as though buyers may have despaired at finding good support.

STRATEGIC ALLIANCES MAKE ODD BEDFELLOWS

Developments in the PC market are a lot like international relations. Springtime product-launch offensives may lead to an all-out price war. Major manufacturers maintain spheres of influence around corporate customers that they protect with heavy artillery. And, in times of relative calm, companies will form strategic alliances to better prepare them for the power plays on the horizon.

This winter was a time of pact making. In February, Hewlett-Packard and 3Com signed a treaty. Soon after, Novell announced a pact with 23 hardware vendors. And Microsoft said it was strengthening ties with Unix developer Santa Clara Operations (SCO).

HP's new relationship with 3Com promises joint product development that helps each company's long-range strategies. HP will standardize on *3+Open*, 3Com's version of Microsoft's *OS/2 LAN Manager*, for PC and minicomputer connectivity. In return, 3Com will lend a hand in the development of HP's *LAN Manager/X*, a Unix network operating system that neatly ties into *OS/2 LAN Manager*. The friendship also guarantees that HP's *NewWave*—the OS/2 application generator that Apple found so offensively derivative of the Mac interface—will run on *3+Open*.

Meanwhile, 3Com's archrival, Novell, lined up support from virtually every major manufacturer of mini and mainframe computers (aside from IBM) for Novell's own Open Systems strategy.

IBM is firmly backing the Microsoft/3Com *OS/2 LAN Manager* strategy, so that's all the more reason for Unisys, Sun, NCR, Data General, and Prime Computer to stand behind Novell's plan for broadening *NetWare*'s reach. (A version of *NetWare* already exists for DEC hardware.)

> Novell lined up support from virtually every manufacturer (aside from IBM) for its own Open Systems strategy.

Novell will provide hardware vendors with code that allows any supported system to talk directly with PCs running *NetWare*. Called *Portable NetWare*, the software was designed for portability and should need only minor modifications before a hardware vendor compiles it on its system.

Novell needs such an outreach program to fend off the threat that Microsoft, 3Com, and IBM have devised with *LAN Manager*. Curiously, Hewlett-Packard is working both sides of the fence: it also pledged support for *Portable NetWare*.

And finally, Microsoft strengthened the long-running relationship it has enjoyed with Santa Clara Operations. The two companies have worked together since 1981 on Xenix and now Microsoft has said it will buy up to twenty percent of SCO.

You might say that Microsoft is hedging its bets on the continued dominance of DOS and OS/2. Yet the real reason for this alliance is so that Microsoft can keep Unix moving on a parallel path with OS/2. The recent choice of the Presentation Manager and DEC's X Windows as standards for Unix's graphic interface by the Open Software Foundation (see Pipeline, March 28, 1989) means that Microsoft has an excellent chance to guide and profit from the growth of Unix, without hurting the company's investment in DOS and OS/2.

SQL Server: More of a Concept Than a Product

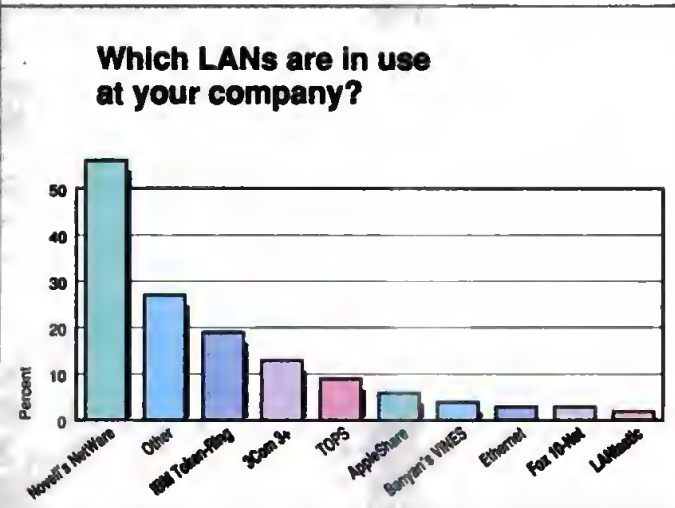
For Novell to effectively resist the *OS/2 LAN Manager* juggernaut, it needs to undermine one of the most compelling reasons to buy it: the ability to run Microsoft/Ashton-Tate/Sybase SQL Server. IBM will have its own LAN Server hooking into OS/2 Extended Edition, but there's a lot of momentum behind SQL Server.

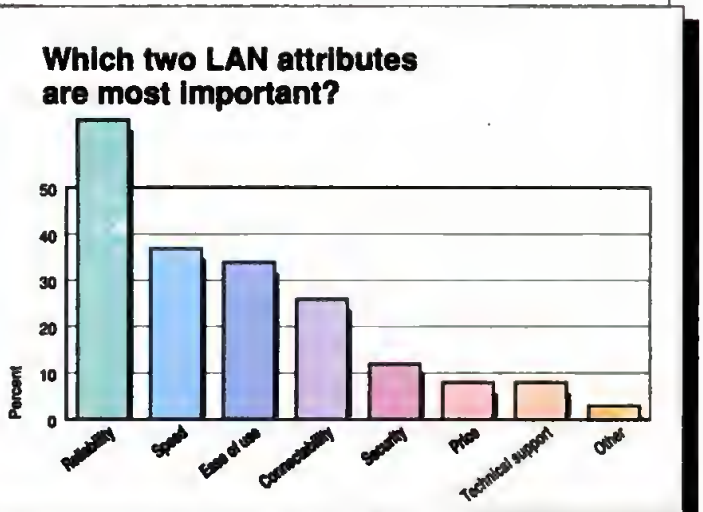
Novell has reached for the same partner Lotus befriended for this battle: Gupta Technologies. *NetWare SQL*, a server-based database manager, will be linked to Gupta's *SQLBase*, also a server-based database manager.

Lotus announced a similar deal with Gupta last year, in which Lotus said it would develop its own database products but would defer to Gupta's *SQLBase* as a server engine.

Microrim plans to leapfrog everybody by introducing a full-blown graphical object-oriented SQL database system with an application generator. It will run under both DOS and OS/2 but won't start shipping until late in the year.

—Gus Venditto





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MicroSTEP Builds Applications From Flowchart Specifications

PC HANDS ON

BY ROBERT L. HUMMEL

Forget everything you've heard about computer-aided software engineering (CASE) tools. Syscorp International's *MicroSTEP* application generator brings substance to a field typically characterized by hype and empty promises.

MicroSTEP lets you build complex applications without writing a single line of code. Instead, you design the application by building a flow chart. Once you're through, *MicroSTEP* automatically generates and compiles the corresponding C code and links it to produce a standalone .EXE application program.

Developing an application using *MicroSTEP* is a surprisingly simple process. The graphical user interface provides a collection of icons along the left border of the screen. Some icons represent a major system component, such as a database, printed report, input screen, or disk file. Others define how data is processed or transferred from one system component to another.

To specify system components, you simply click on the appropriate icon and place it on a screen. Once the system components are placed, you build the specific data structures. A click of the mouse button creates a field, and a dialog box prompts you for information such as name and data type.

Using this approach, describing how data is processed becomes trivial. For example, the process "Using the customer name, check the database for the customer; if found, retrieve the customer's mailing address and loan balance" is expressed as a line drawn from the database fields to the corresponding screen fields. To express the idea of retrieving all customers who owe more than their credit line, you click on the DEBT field in the CUSTOMER record, type >, and click on the CREDITLIMIT field. A dozen clicks of the mouse can create a process it would take me a dozen pages to explain.

There's no need for a separate screen or report builder. Both are built right into the development environment and are simple to use. To display a customer's phone number on the screen, for example, you bring the data record into the reference window, click on the phone number field, then click on the screen template shown in the active window. A picture specification appears and can be moved at will.

When the application specification is complete, *MicroSTEP* will actually write the code based on your graphic specification. First, the program examines the entire specification for consistency and completeness. Anything you may have overlooked, such as a data field definition, is pointed out so that you can correct it.

MicroSTEP then reads your specification and generates C code. The program allows you to examine the C code if you want to, but you don't have to deal with the source code at all. *MicroSTEP* automatically compiles and links the source code to produce a standalone .EXE program. All of the library routines needed are linked into the file, and there is no license fee.

You can build applications without having to know specifics about filenames, data tables, or hardware on the target system. A comprehensive installation program handles these options and lets you customize screen colors and default key assignments.

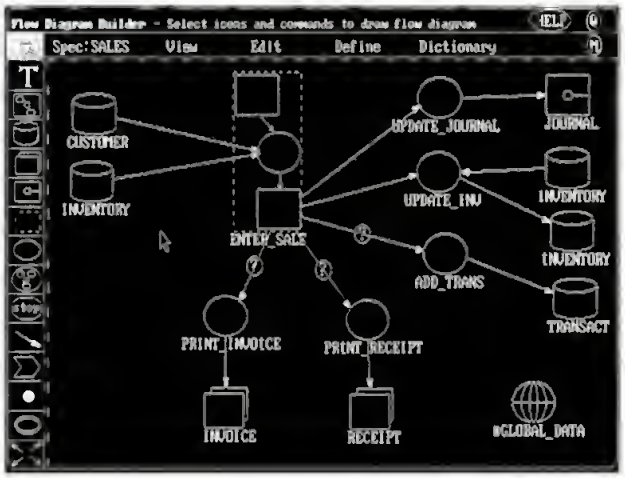
The *MicroSTEP* package includes a comprehensive hands-on tutorial that guides you through the creation of a typical point-of-sale database application. The tutorial is geared for experienced programmers, but it should be understandable to anyone with some programming or database design experience.

It took me about 4 hours to perform the tutorial from start to finish. Generating an executable program from the specification took about 25 minutes more. The result was a 610K .EXE file and an application that looked and performed exactly as I expected. Producing the same application using conventional programming would have taken at least ten times as long.

All this capability comes at a price—and I don't mean the $5,000 price tag. *MicroSTEP* is a memory hog. Written in C, it requires that your PC have 565K of RAM available to load and run programs. For me, that means booting up my computer without any memory-resident programs, RAMdisks, or disk caches. It also means that it won't run under DOS 4.0. The six 1.2MB program floppy disks occupy about 6MB of disk space and, since *MicroSTEP* is a graphics-based program, it requires that the development machine be equipped with either a Hercules or EGA graphics card and a mouse. The generated applications are text based, so no special equipment is needed to run them.

Unfortunately, the applications produced by *MicroSTEP* are strictly for single users and cannot be used in a shared-file network system. Syscorp expects to ship a version that produces network-compatible applications this summer.

MicroSTEP is a powerful application-development environment that allows experienced systems programmers and business analysts to be more efficient and productive than ever. The increase in productivity makes the package well worth its hefty price.



MicroSTEP *makes it easy to build program specifications like the one above. It then automatically generates, compiles, and links the corresponding C code.*

PC MAGAZINE FACT FILE

MicroSTEP
Syscorp International
9420 Research Blvd., #200
Austin, TX 78759
(512) 338-0591
List Price: $5,000
Requires: 565K free memory; Microsoft-compatible mouse; Hercules or EGA graphics card; hard disk; DOS 3.1, 3.2, or 3.3.
In Short: An easy-to-use, graphics-based package that builds standalone applications in C from flowcharts you define. Not copy protected.

CIRCLE 434 ON READER SERVICE CARD

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LaserMaster Doubles LaserJet Resolution, Provides Scalable Fonts to 1,200 Points

PC HANDS ON

BY EDWARD MENDELSON

Until a few weeks ago, the next step up from the 300-dot-per-inch desktop laser printer was the 600-dpi Varityper VT-600. Compared with the HP LaserJet Series II, the VT-600 gave you four times better resolution at about ten times the total cost. If you wanted anything in between those two printers, you were out of luck.

Now the LaserMaster LX6 Professional Controller card transforms the HP LaserJet Series II into a printer with twice its original resolution—600 by 300 dots per inch. That means text without the obviously jagged edges of even the best 300-dpi LaserJet and PostScript fonts, and it means printed graphics with clarity and detail never seen before in a desktop printer.

The LaserMaster LX6 also lets you print scalable fonts in any size up to 1,200 points, even in applications that normally don't allow large-size type, and you get more-flexible, compatible printing all around. The LaserJet with a LaserMaster LX6 is the only current product that correctly prints everything on the *Ventura Publisher* "capability" page.

The LaserMaster LX6's onboard processor and 4MB of RAM (upgradable to 6MB) also give your LaserJet a satisfying speed boost.

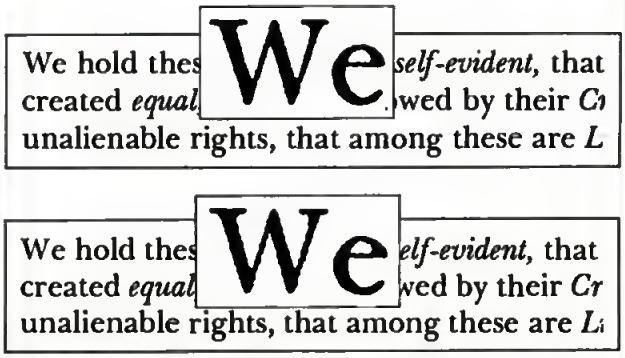
Unfortunately, these substantial features come at a substantial price: the LaserMaster LX6 lists for a hefty $3,995. That's more than twice the street price of the LaserJet itself.

The LX6 package consists of a full-length 8-bit board that fits into any slot in your PC and a smaller board that plugs into the optional I/O port of the LaserJet Series II (or other second-generation Canon-engine laser printer). A thin telephone-style cable connects the two boards.

The LaserMaster LX6 achieves its high resolution by forcing the printer to change the way it positions dots. The LaserMaster LX6 can double the LaserJet's horizontal resolution electronically, but it can't alter the LaserJet's vertical resolution, which is a function of the way the paper moves through the printer.

summer, and LaserMaster will have a driver ready for *Microsoft Word* 5.0 as soon as the program hits the streets.

Any program that doesn't support the LaserMaster LX6 can still print to the LaserJet in the usual way, although the difference in quality between standard LaserJet printing and LX6 printing is so striking that



The LaserMaster LX6 Professional Controller doubles the LaserJet Series II's horizontal resolution. Above, the type printed with the LaserMaster installed (top) is smoother, though the difference seems slight to the naked eye.

To install the LaserMaster LX6, you simply plug the board into the computer and run a program that copies about 3MB of fonts and other files to your disk. When installation is complete, a simple command (which you can include in your AUTOEXEC.BAT) gets the board ready for action in about 5 seconds. Comparable PostScript boards take as much as ten times longer before they let you print.

PostScript Fonts

The LaserMaster LX6 comes with 35 Bitstream font outlines that correspond to the 35 fonts built into current PostScript printers. You can add any other font from the 200 currently available in Bitstream's *Fontware* typeface packages. LaserMaster supplies drivers and screen fonts for *Microsoft Windows* applications like *PageMaker* and *GEM* applications like *Ventura Publisher*. *WordPerfect* will release a driver for the LaserMaster LX6 this

you probably won't want to.

The LaserMaster LX6 doesn't restrict you to the standard portrait and landscape fonts. In *PageMaker* and *Ventura Publisher* you can take any text and apply advanced PostScript-style special effects such as sloping, shadowing, stretching, or any fill pattern you choose. A special-effects editor lets you select from predefined effects or create new ones, including customized fill patterns.

The 35 fonts that now come with the LaserMaster LX6 include the 210 characters in the PostScript symbol set. The next version of the board's software, scheduled for release around the time you read this, will allow typographically sophisticated applications like *WordPerfect* to access all 560 characters in the complete Bitstream character set.

Perfection

At $3,995, a printer add-in board ought to be perfect, and the LaserMaster LX6 comes close. The only problem I encountered in 2 months' use was a solvable problem in *PageMaker*. When printing gray-scale TIFF files at 600 by 300 dpi, *PageMaker*'s default settings produced dots that were more like lozenges than circular dots. The solution was to change *PageMaker*'s default of 53-line-per-inch images to between 80 and 105 lines. *Ventura Publisher* sorts out this problem by itself.

Gray-scale images printed with the LaserMaster LX6 can't equal the quality of the same files printed with Intel's Visual Edge board, but they come close—and the Visual Edge does nothing to improve text printing or line art. You can't use the Visual Edge and the LaserMaster LX6 at the same time, since each needs the same I/O slot on the LaserJet.

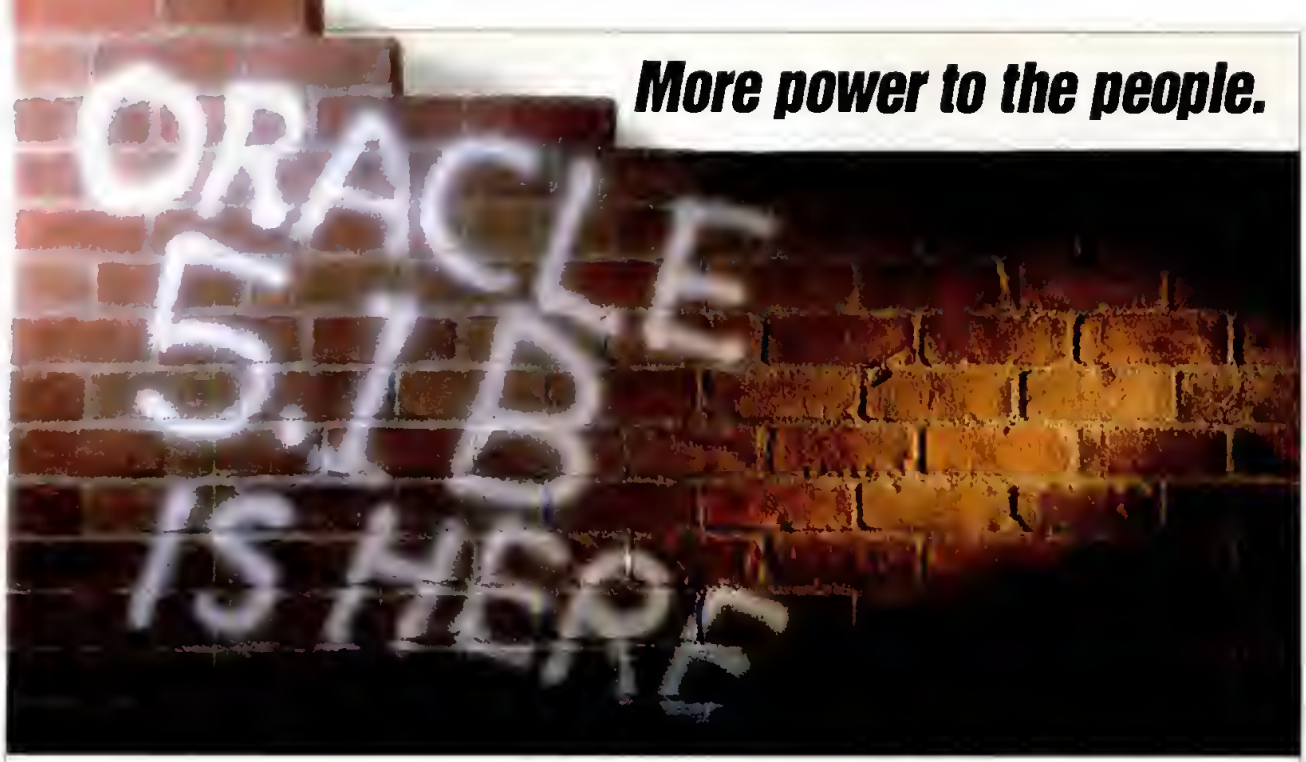
If you can afford the high cost of the LaserMaster LX6, you will be rewarded with the finest—and almost the fastest—printing available on a desktop. Even the 400-dpi PostScript printer that comes with the NeXT computer has notably lower resolution. With the introduction of the LaserMaster LX6, for the first time, desktop publishing stops looking like something produced on a desktop and starts looking like the real thing.

PC MAGAZINE FACT FILE

LaserMaster LX6
Professional Controller
LaserMaster Corp.
7156 Shady Oak Rd.
Eden Prairie, MN 55344
(612) 944-9069
List Price: $3,995
Requires: HP LaserJet Series II or IID, Canon LBP-8II, Brother HL-8, or other second-generation Canon-engine laser printer; hard disk.
In Short: A fast but expensive add-in board that doubles the print resolution of the HP LaserJet Series II and provides scalable fonts.

CIRCLE 446 ON READER SERVICE CARD

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PC MAGAZINE EDITORS' CHOICE May 17, 1988

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CrossFile Simplifies Data File Translations

PC HANDS ON

BY CRAIG STINSON

This seems to be the season for utilities that massage and convert database files from one proprietary format to another. The latest to appear is *CrossFile*, from Saxon Systems.

Unlike Tools & Techniques' *Data Junction* (see First Looks, *PC Magazine*, April 11, 1989), *CrossFile* is strictly a conversion package. It doesn't include a data-entry front end, nor does it allow you to edit the actual contents of fields and records as they pass from one format to another. It does offer a couple of its own nifty twists.

Twist number one is a TSR module called Capture that grabs data on its way to your printer and shunts it off to a file in your *CrossFile* subdirectory. That file can serve as fixed-width ASCII input for conversion to, say, *Lotus 1-2-3*, *dBASE*, *Quattro*, or *Microsoft Excel*. All decent programs include their own print-to-file options, so Capture probably doesn't provide any capability you don't already have. But it may simplify your life. Capture uses either 37K or 49K of RAM, depending on whether you need to capture data in graphics mode, and you can easily remove it from memory.

Twist number two is an attractive, visually oriented user interface that resembles that of a spreadsheet. You specify the way you want your data converted by stretching a highlight across the appropriate rows and columns.

The typical *CrossFile* session runs like this: you start by selecting an input file type, choosing from ASCII (fixed or delimited), Lotus (*1-2-3*, Version 1A or 2, or *Symphony*), *Excel*, *SuperCalc*, *Quattro*, and .DIF formats. *CrossFile* presents a list of the files it finds in that format, and you point to the one you want.

Your file comes up table-style in a full-screen window. You put a bar cursor on the first line of the table's title, assuming there is one. Press Enter, stretch the highlight to the last line of the title, and press Enter again. Repeat the process for as many rows of field headings as you have. Then repeat the process using a vertical bar cursor to define the width of each field you want to translate.

You can choose fields in any order, and you simply omit any you don't need converted. *CrossFile* automatically recognizes three data types—character, numeric, and date. It prompts you for a decision if there's any ambiguity.

After choosing fields, you get to specify any record-filtering criteria you need. The basic relational operators (greater than, less than, equal, not equal) are available, and you can use AND and OR to join criteria involving multiple fields. Unfortunately, you can't specify criteria that involve fields you don't plan to translate. All criteria information gets written off to a file, so you don't have to repeat these steps the next time you convert the same file in the same manner. Next time, you can run the whole process from the DOS command line.

The final step is the selection of an output file type and filename. *CrossFile* supports the same set of file types for output as for input.

The only apparent hitch is that *CrossFile* aborts the translation when certain TSRs are present. It failed, for example, when *SideKick* was in memory, and it failed when run from *The Norton Commander*, though it ran fine from the DOS 4 Shell. Worse, the program presents an undocumented error message under these conditions.

One other complaint: the program's input file-selection window assumes the extension .CAP for ASCII files. You can enter your own filename on a command line if it's not a .CAP file, but the ability to put a wildcard spec on the command line and have the window display matching files somehow got left out of the program design.

These shortcomings aside, and assuming the bug gets fixed, *CrossFile* is an attractive program that fills a real need. It's less malleable than its competitor *Data Junction*, and it lacks the latter's data-entry module. But for straightforward conversions, *CrossFile* seems a mite simpler to use. PC

List Price: *CrossFile*, $149.95.
Requires: 512K RAM, DOS 2.0 or later. Not copy protected. Saxon Systems, 18007 Kensington Ave., Cerritos, CA 90701; (213) 404-4030.

CIRCLE **451** ON READER SERVICE CARD

Intel's Send-Off! for Lotus 1-2-3 Delivers No-Frills Background Fax

PC HANDS ON

BY LORI GRUNIN

If you purchased the Intel Connection CoProcessor for its background fax and file-transfer capability and then belatedly discovered that you still needed to leave your application to control communications, Intel's *Send-Off! for Lotus 1-2-3* might mollify you somewhat.

The easy-to-use *Lotus 1-2-3* add-in, free to registered users of the Connection CoProcessor (see the review in First Looks, *PC Magazine*, December 13, 1988), allows you to send faxes and files from the background while running *1-2-3*. When active, *Send-Off!* requires approximately 30K of free RAM, not including the 16K taken by *1-2-3*'s Add-in Manager.

For faxes, *Send-Off!* lets you choose between standard (200- by 100-dot-per-inch) and fine (200- by 200-dpi) text resolution and normal or compressed fonts. An optional cover sheet may be sent with or without a user-defined logo, and you can control the date and time of transmissions. A status log keeps track of transmissions.

If you want to fax a worksheet, you need to open it; while it's possible to fax the current worksheet, you can't similarly transmit a .WK1 file. If you need to send a worksheet file over the wires, you'll have to transfer it—provided the recipient also has a Connection CoProcessor.

In a rather odd omission, *Send-Off!* leaves out the ability to update a phone book on the fly and view faxes before transmission. The software that accompanies the Connection CoProcessor handles these tasks and more, but you'll have to exit *1-2-3* to get to it.

Intel Corp. should be offering a similar product for *WordPerfect* 5.0 by the time this issue hits the newsstand.

Send-Off! for 1-2-3 begins to fulfill the promise of the Connection CoProcessor, and it's certainly good news to those who already own the board. However, for those who are still thinking about buying the $995 board, this unremarkable add-in hardly provides a strong justification. Granted, it gives you background fax functionality from within *1-2-3*, but its minimalist approach doesn't realize the Connection CoProcessor's potential. PC

List Price: *Send-Off! for Lotus 1-2-3*, Free to registered users and new buyers of Intel/DCA's Connection CoProcessor.
Requires: 30K free RAM; Intel Connection CoProcessor; *Lotus 1-2-3*, Release 2.0 or later; DOS 2.0 or later. Not copy protected. Intel Corp., PCEO, 5200 NE Elam Young Pkwy., Hillsboro, OR 97124; (800) 538-3373.

CIRCLE **447** ON READER SERVICE CARD

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PC WEEK "CPU 386/25. Its performance is top notch" Feb 89

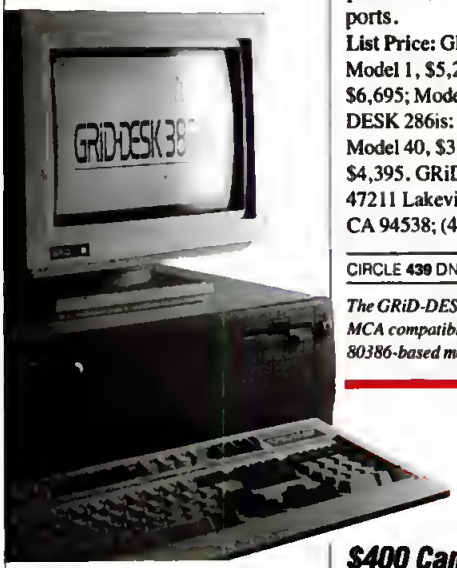
CIRCLE 163 ON READER SERVICE CARD

NEW ON THE MARKET

by Lori Grunin

GRiD Throws Hat into Desktop Ring with 386 MCA, 12-MHz AT

GRiD Systems Corp.'s first foray into the world of desktop computing consists of two computers manufactured by Tandy Corp., GRiD's parent company: the GRiD-DESK 386mc, a 20-MHz 80386-based Micro Channel machine, and the GRiD-DESK 286is, a 12-MHz AT compatible.



The GRiD-DESK 386mc offers MCA compatibility in a 20-MHz 80386-based machine.

2MB of 120-nanosecond SIMMs, expandable to 16MB, and a 32K cache populate the 386mc's motherboard in its standard configuration. The GRiD-DESK 386mc Model 40 ($6,695) and Model 80 ($7,195) contain 40MB and 80MB SCSI hard disk drives with 19-millisecond access times: buyers of the Model 1 ($5,295) can choose their own drive and controller combination.

Five slots—two proprietary 32-bit and three 16-bit—facilitate expansion. The drive controller occupies one slot in the the Models 40 and 80.

The GRiD-DESK 286is Model 1 ($2,695) features six expansion slots, four 16-bit and two 8-bit. As with the 386mc, you lose one 16-bit slot to the drive controller in the Model 40 ($3,895) and Model 80 ($4,395). You can expand the standard 1MB of RAM to 14MB.

All models of both systems come equipped with an 8-bit VGA card, a 3½-inch high-density drive, a socket for an Intel math coprocessor, and serial, parallel, mouse, and printer ports.

List Price: GRiD-DESK 386mc: Model 1, $5,295; Model 40, $6,695; Model 80, $7,195. GRiD-DESK 286is: Model 1, $2,695; Model 40, $3,895; Model 80, $4,395. GRiD Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94538; (415) 656-4700.

CIRCLE **439** ON READER SERVICE CARD

$400 Camera-Board Combination Digitizes Gray-Scale Images

As an inexpensive alternative to an elaborate TV camera and frame-grabber board setup, **Electrim Corp.** offers the $400 EDC-1000, a small camera, 8-bit half-card, and software combination that captures and digitizes images with up to 256 shades of gray.

The software allows you to control exposure and frame-scanning time as well as integrate multiple images to compensate for a low signal-to-noise ratio. You can save images in either .PCX or TIFF file formats.

To help customize the C-based program, Electrim provides routines compatible with Turbo C, Microsoft C, Turbo Pascal, and BASIC that can be linked to the software. A $160 12½- to 75-millimeter zoom lens is optional.

List Price: Electrim EDC-1000, $400; zoom lens, $160. **Requires:** 256K RAM, graphics adapter,



You can buy a $160 zoom lens to capture images up close and personal with the Electrim EDC-1000.

DOS 2.1 or later. Software not copy protected. Electrim Corp., P.O. Box 2074, Princeton, NJ 08543; (609) 799-7248.

CIRCLE **442** ON READER SERVICE CARD

Two Ways to Convert VGA to NTSC

If you love the presentations you can generate with your computer but hate being tied down to the system when displaying your handiwork, two products that convert VGA signals to VCR-recordable output may be your ticket to freedom.

US Video's $785 Recordable VGA board generates an NTSC (National Television Standards Committee) composite signal, as well as VGA output at resolutions of up to 1,024 by 768 pixels by 16 colors.

If you just want to convert your VGA card's signals into NTSC output, **Jovian Logic** of-

(continues on page 52)

HOT PROSPECT

Zero-Slot IBM PS/2 Model 30 286 Replacement Drives

If you've wanted to replace the small, lethargic IBM hard disk drive in your PS/2 Model 30 286 but are unwilling to sacrifice one of your precious three expansion slots for the necessary controller card, **Procom Technology** may have the drive you've been waiting for.

The company offers 40MB and 100MB drives, the 28-millisecond PIRA-40 ($895) and the 25-ms. PIRA-100 ($1,895).



Procom Technology's PIRA hard disk drives let you boost the storage capacity of your IBM PS/2 Model 30 286 without giving up an expansion slot.

Both 3½-inch disk drives have embedded controllers that use 2,7 RLL encoding and obviate the need for an expansion slot.

In contrast to the IBM disk drive, which uses an 8-bit data path and has an average data transfer rate of 218K per second, the PIRA drives take advantage of the AT-bus's 16-bit data path and achieve an average data transfer rate of 1MB per second. Both of Procom's drives have a 1:1 interleave, compared with the IBM's 2:1 ratio.

Procom includes all the hardware needed for installation.

List Price: PIRA-40, $895; PIRA-100, $1,895. **Requires:** IBM PS/2 Model 30 286. Procom Technology Inc., 200 McCormick Ave., Costa Mesa, CA 92626; (714) 549-9449.

CIRCLE **436** ON READER SERVICE CARD

NEW ON THE MARKET

VGA Boards

(continued from page 51)

fers the $395 V1N—or VGA/RGB into NTSC—encoder. Automatic signal switching renders operation transparent to most software, according to the company.

The V1N routes output from a VGA card to a display and TV or VCR. It accepts as input an analog RGB signal with scan rates of 15.75 kHz horizontal and 60 Hz vertical, interlaced and noninterlaced.

List Price: Recordable VGA, $785. US Video, 1 Stamford Landing, 62 Southfield Ave., Stamford, CT 06902; (203) 964-9000.

CIRCLE **440** ON READER SERVICE CARD

List Price: VtN, $395. **Requires:** Software: 640K RAM, DOS 2.0 or later. Not copy protected. Jovian Logic Corp., 42808 Christy St., #230, Fremont, CA 94538; (415) 651-4823.

CIRCLE **441** ON READER SERVICE CARD

ShortCut Card Upgrades 8088-, 8086-based Systems

Since XT accelerator cards rarely work with both the 8088 and the 8086 processors, installations with both types of machines can be quite a challenge for you to upgrade. **Tallgrass Technologies'** $495 ShortCut accelerator card adds to the small list of inexpensive 80286 upgrade alternatives for PC managers.

The accelerator card, which takes up a half-slot in your machine, hosts a 12.5-MHz 80286 processor with a 16K 100-nanosecond RAM cache, as well as an optional 80287 math coprocessor. Your old 8086/88 chip resides on the card; a toggle switch allows you to flip between processor modes to accommodate recalcitrant application software.

The ShortCut's $295 memory option enables your machine to address up to 16MB of 16-bit RAM: it adheres to both LIM EMS 4.0 and EEMS. A $149 floppy disk controller supports up to four floppy disk drives of any size or density and offers a parallel and a serial port.

List Price: ShortCut, $495; memory option, $295; floppy disk controller option, $149. **Requires:** 8088- or 8086-based machine. Tallgrass Technologies Corp., 11100 W. 82nd St., Overland Park, KS 66214; (913) 492-6002, (800) TAL-GRAS.

CIRCLE **437** ON READER SERVICE CARD

Mouse-Trak Trackball Plugs into PS/2 Mouse Port

ITAC Systems comes to the aid of PS/2 users in search of alternate input devices with their Mouse-Trak, a heavy-duty trackball that plugs directly into the PS/2's mouse port.

The Mouse-Trak's controller operates as well on your lap as on your desk, according to the company, and is constructed with stainless-steel shafts and ball bearings.

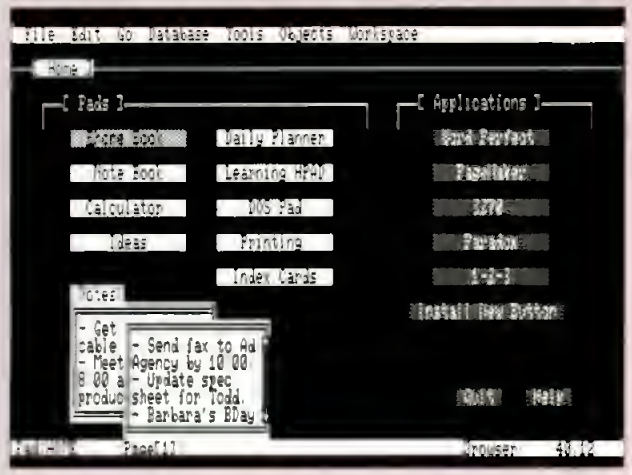
Available in both two- ($169) and three-button ($179) models, the trackball features user-definable input keys, customization of dragging mode, and a speed/resolution control button that allows for ballistic gain on the low-speed setting. The third button on the three-button model can be programmed in tandem with the other two.

List Price: Mouse-Trak, two-button model, $169; three-button model, $179. **Requires:** IBM PS/2 or compatible. ITAC Systems Inc., Garland, TX 75042; (214) 494-3073.

CIRCLE **443** ON READER SERVICE CARD

HyperPAD: Character-based HyperCard Clone for the PC

Apple introduced many unsuspecting Macintosh users to the joys of object-oriented programming with *HyperCard*, a program and script language that allows users to easily create customized applications. Although **Brightbill-Roberts's** $99.95 *HyperPAD* differs in many ways from the Macintosh offering, the company hopes its product will spur a similar craze in MS-DOS users.



You can take advantage of HyperPAD*'s linking capabilities to create applications, such as this DOS shell.*

A *HyperPAD* pad, comparable to a *HyperCard* stack, is a customized application: *PAD* stands for *personal application designer*. For instance, you can create a DOS shell from which to launch other applications—*HyperPAD* shrinks to 2K when starting another program.

Other possible types of applications include a data-entry interface for a database, or an interactive tutorial. Basic database capabilities are built into the program. Unlike its Macintosh analog, *HyperPAD* uses character-based instead of graphics screens, and the mouse is optional.

The program's object-oriented scripting language, PADTalk, has objects such as buttons, fields, and pages that can be linked, moved, cut, and pasted. The language also controls the importing and exporting of .DBF and ASCII-formatted files.

HyperPAD comes with over 24 prewritten pads, such as a DOS pad that handles file and disk operations, an address and phone list, a daily planner, and a time billing system. With *HyperPAD Reader*, a $495 runtime version of the program, other users can browse through and edit the information but not change a pad or its objects.

List Price: *HyperPAD*, $99.95; *HyperPAD Reader*, 25-copy distribution, $495, unlimited distribution, $3,000. **Requires:** 384K RAM, DOS 2.1 or later. Not copy protected. Brightbill-Roberts & Co. Ltd., 120 E. Washington St., #421, Syracuse, NY 13202; (315) 474-3400.

CIRCLE **438** ON READER SERVICE CARD

FASTMICRO

ORDER LINE:
1-800-441-FAST

RGB Color Monitor
by Samsung



$199

These 14" monitors were purchased from a large PC manufacturer who was overstocked. They are brand new with one year warrantees and are made by Samsung. They are fully CGA compatible and work with PC compatibles. A CGA (640 x 200 resolution) card is just $49 and comes with a printer port. This is the perfect video combo for your new XT or AT clone.

SPECIALS

WordPerfect 5.0



$215

The most popular word processor is now even better than ever! Version 5.0 adds multiple font support, graphics integration, page preview and much more. WordPerfect 5.0 still retains its feel and ease of use that made it #1. Combine this with the best support in the industry and you can't lose.

FoxBASE+

$185



FoxBase+ 2.10 is simply the fastest dBASE compatible database software available. FoxBase+ also adds many enhancements to the dBASE language. And it's user-friendly too, its FoxCentral uses pull-down and pop-up menus and you can perform every important database operation without programming! There are even LAN, runtime, and 386 FoxBase versions available.

HARDWARE

PRINTERS

	LIST	FAST
ALPS		
Allegro 24	499	315
Citizen		Call
Diconix		
150P	499	299
Epson		Call
Fujitau		
DL3400	995	549
NEC		
P2200	569	339
P5200	799	509
P5300	1049	669
LC890	4799	Call
Okidata		
182 Plus	319	219
320	499	329
390	699	469
393	1499	949
Panasonic		
KXP1180	300	Call
KXP1191	400	Call
KXP1124	529	309
KXP1595	749	419
KXP1524	949	519
KXP4450	2595	1479
Star		
NX1000	289	169
NX2400	499	299
Toshiba		
P321SL	749	459
P341SL	999	599
P351SX	1499	929

FAX MACHINES

	LIST	FAST
Murata M1200	899	699
Murata M1600	1599	849
Toshiba 3010O	1396	949

BOARDS

	LIST	FAST
AST		
Hot Shot 286	645	339
Six Pak Plus 64K	210	119
Everex		
1200B Int Modem	149	69
2400B Int Modem	249	129
EVGA	499	249
Genoa		
Super EGA Hi-Res+	399	179
Super VGA #5100	445	239
Super VGA #5300	499	299
Super VGA #5400	699	419
Harcules		
Graphic Card +	299	169
Intal		
8087-2	250	139
80287-10	480	249
80387-20	730	449
Above Board Plus	795	395
Orchid		
ProDesigner	499	297
ProDesigner Plus	599	397
Tiny Turbo 286	445	269
Paradise		
Autoswitch 480	349	179
VGA Plus	399	255
VGA Plus 16	499	295
VGA Professional	799	479
Practical Peripharala		
1200B Int Modem	99	60
2400B Int Modem	199	149
Prometheus		
Promodem 2400B	199	129
Promodem 2400G	249	149

The Complata PC	LIST	FAST
Answering Machine	349	209
Fax 4800	399	225
Hend Scannar 400	249	139
USRobotics		
1200 Baud Internal	149	69
1200 Baud External	179	89
2400 Baud Internal	249	119
2400 Baud Externel	279	149
Video 7		
Fast Wnte VGA	549	335
Vega Deluxe	379	Call
Vega VGA	499	259
V-RAM VGA	799	469

LAPTOPS

	LIST	FAST
Magahertz Modema		
2400B Toshiba	299	149
2400B NEC, Epson Mitsubishi or Zenith	399	199
Mitsubishi		
MP-286L Dual	3195	1879
MP-286L 20mb	4595	2449
NEC		
Multispeed EL II	2295	1449
Multispeed HD	3695	2249
Toshiba		
T1000	1249	759
T1000 768k Card	399	269
T1200F	2099	1369
T1200FB Becklit	2399	1499
T1200HB Backlit	3599	2399
T1600	4999	Cell
T5100	7499	4495
Zenith		Cell

MONITORS

	LIST	FAST
Magnavox		
7BM749 VGA	229	149
9CM082 VGA	649	419
Mitaubishi		
1409 RGB	399	259
1410 EGA	599	339
Diemond Scen 1381	799	479
NEC		
Multisync 2a	799	Call
Multisync Plus	1399	869
Princeton		
Max15	389	Call
Utltrasync	849	479
Utltra 16	1375	859
Seiko CM1430	995	599
Sony		
1302 Multiscan	995	659
1303 Multiscan	825	449
Zenith 1490	999	599

DISK DRIVES

	LIST	FAST
Miniscribe		
40MB AT #3650	499	319
Mitaubishi		
40MB AT MR535 22ms	825	399
Seagate		
20MB XT Kit #225	599	267
30MB XT Kit #238	699	287
40MB AT #251	899	349
40MB AT #251-1	999	449
80MB AT #4096	1199	549
Toshiba		
360K Floppy	119	69
720K 3.5" Floppy	149	79
1.2MB 5.25" Floppy	149	79
1.44MB 3.5" Floppy	189	99

Call On Non-Listed Items

SOFTWARE

Database

	LIST	FAST
Clipper	699	399
DataEase	600	389
dBase IV	795	439
dBXL Diemond	199	105
Foxbase Plus	395	185
Foxbase Plus Lan	595	295
Paradox 3.0	725	459
RapidFile	295	179
Rbase for DOS	700	Call
Reflex	150	90
Q & A	349	199
Q & A Lan Pack	299	185
Quicksilver	599	329

Desktop Publishing

	LIST	FAST
Byline	295	175
GEM Desktop Pub.	299	169
Pagemaker	795	Call
PFS:First Publisher	129	69
Publisher's Peintbrush	285	149
Ventura	895	489

Financial

	LIST	FAST
Bedford Integr. Acct.	249	139
Computer Assoc. BPI		Call
DAC 3.0	99	59
DAC Payroll 3.0	99	59
Dollars & Sense	179	99
Managing Your Money	199	117
Peachtree Complete II	199	149
Turbo Tax 1040	75	42

Graphica

	LIST	FAST
Deluxe Paint II	105	67
First Grephics	129	Call
Freelance Plus	495	Call
GEM Artline	495	269
GEM Drew Plus	299	165
Generic Cadd Level 3	250	149
Graph Plus	495	299
Harverd Graphics	495	Call
Parspective Jr.	149	85

Integrated

	LIST	FAST
First Choice	159	89
Works	149	89
Windows 286	99	59
Windows 386	195	117

Mice

	LIST	FAST
Keytronics Serial or Bus	119	75
Logitech Serial or Bus	119	65
Logitech New HiRes	139	85
Microsoft Serial or Bus	150	95
Microsoft W/ Windows	200	129
QmniMouse Serial	89	39
PC Mouse II Serial or Bus	149	82

Power Protection

	LIST	FAST
Curtis Ruby Plus	115	59
Datasheild 85	90	50
Detasheild 100	99	57

Programming

	LIST	FAST
Macro Assembler	150	89
Norton Guides (Specify)	100	58
Turbo Basic	99	60
Turbo C 2.0	149	90
Turbo Pascal 5.0	149	90
Quick Basic	99	60
Quick C	99	60

Spreadsheets

	LIST	FAST
Allways	150	82
Excel	495	Call
Lotus	495	Call
Lucid 3-D	99	59
Quattro	248	149

Utilities

	LIST	FAST
CoreFast	149	71
Desklink	170	95
Desqview	130	73
Fastback Plus	189	99
FastTrax	60	37
Formtool	95	54
Laplink Plus	140	75
MS-Dos 4.01	149	85
Norton Advanced	149	74
PC Tools Deluxe 5.1	80	37
SideKick Plus	199	119
XTree Pro	129	61

Word Processors

	LIST	FAST
Ami	149	89
Easy Extra	99	55
GEM First Word Plus	199	117
Grammatik III	89	49
Manuscript	495	Call
Multimate Adv. II	565	267
Professional Write	199	109
Rightwriter	95	47
Sprint	195	119
Q & A Write	199	109
Webster's Writer	60	47
Word	450	Call
Word Perfect	495	215
Word Perfect Library	129	60
WordStar Prof. 5.0	495	189

Call On Non-Listed Items

TERMS: Most Orders Ship Within 48 hours. No Charge for Visa or MasterCard. Shipping & handling charge: 3% (Min $4). Product warranties, offers & claims are handled by the manufacturer only. All returns are subject to 15% restocking fee, call for RA number. No returns on used items. Sorry, no COO's. Personal/company checks delay shipping. Compatibility not guaranteed. APO's add $15 per box. Prices/availability subject to change. AZ orders add 6.7% tax. For your protection, we check for stolen credit cards.

Mailing Address:
3721 E. Grove St., Phoenix, AZ 85040
To place orders only call: 800-441-3278
To check on an order call: 602-437-8975

CIRCLE 352 ON READER SERVICE CARD

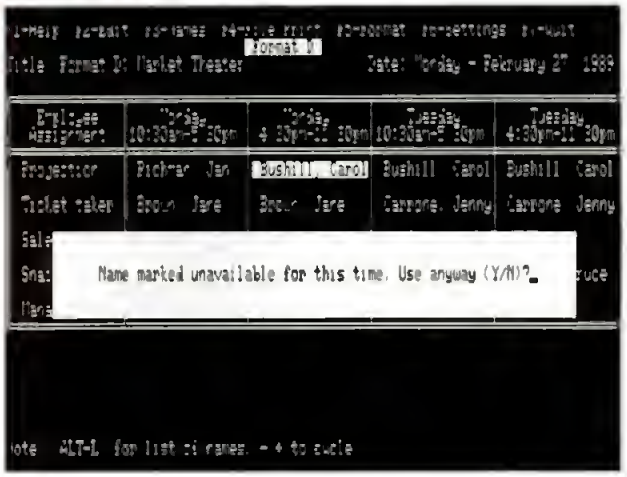
$99.95 Staff Scheduler with Smarts Covers Your Tasks

PC HANDS ON

BY BROOKS HUNT

Scheduling a staff to handle several tasks over several shifts is a tedious process, especially if pencil and paper are your only tools. But with Power Up!'s *Working Hours*, scheduling is much easier. The $99.95 package even helps you make sure all tasks are covered, by letting you review the schedule from several different perspectives. The menu-driven program can handle up to 50 employees.

Once you've entered your staff members' names and personal data, you can start scheduling them with any of six different input screens: time tables, line charts, and shift charts, each of which can be organized either by employee name or task. To make sure that all necessary tasks or operations are covered and that all of your staff members are working the appropriate number of hours, just toggle between screens. It couldn't be easier.



Working Hours *helps you make reliable staff schedules. If you try to schedule an employee to work on her day off, you'll get an error message.*

With *Working Hours*, you schedule a week at a time, in increments of 15 minutes, up to 24 hours per day. And there's some intelligence built in: if you've indicated that some of your staff members aren't available during parts of the period, the program will warn you if you try to schedule them for those times. Once the schedule is set, you can print a master, as well as individual reminders for each staff member.

Working Hours is a handy, inexpensive tool that will help you schedule your staff efficiently, accurately, and easily.

List Price: *Working Hours*, $99.95. **Requires:** 320K RAM, DOS 2.0 or later. Not copy protected. Power Up!, P.O. Box 7600, San Mateo, CA 94403; (800) 851-2917.

CIRCLE **433** ON READER SERVICE CARD

$50 1-2-3 Add-in Lets You Look Up Tables Stored in External Disk Files

PC HANDS ON

BY CRAIG STINSON

The company that brought you *@Wslink*—a Lotus add-in that lets you link worksheet cells to other worksheets on-disk—now offers *@Elookup*, an add-in that lets you search lookup tables stored in external disk files. Goldata's $49.95 product works with both *Lotus 1-2-3* and *Symphony* and handles delimited disk files of any size.

@Elookup adds one function to the Lotus repertoire. You use it the way you would @VLOOKUP or @HLOOKUP, with three arguments—a table name, an index value, and a displacement. The table name, in *@Elookup*'s case, is an ASCII file delimited in some fashion; you can specify the delimiter along with the filename argument if it's not comma-delimited.

@Elookup could prove useful for two kinds of worksheets: ones that access many different lookup tables and ones that need to pluck values out of massive data files. For both, *@Elookup* provides relief from RAM overload. The drawback is a reduction in speed. The size of the speed reduction depends on your hard disk, disk caching, and the size of the lookup file. *@Elookup* itself reduces the amount of conventional memory available to your *1-2-3* worksheet by only 19K.

If you have large data files that you need to access from *1-2-3*, *@Elookup* is well worth its modest price.

List Price: *@Elookup*, $49.95. **Requires:** 384K RAM; *Lotus 1-2-3*, Release 2 or later, or *Symphony*; DOS 2.0 or later. Not copy protected. Goldata Computer Services Inc., 2 Bryn Mawr Ave., Bryn Mawr, PA 19010; (215) 525-1036.

CIRCLE **432** ON READER SERVICE CARD

4DOS Adds Power to the DOS Prompt

PC HANDS ON

BY BARRY SIMON

4DOS is a shareware replacement for COMMAND.COM. Once it's loaded with a "shell=" command in your CONFIG.SYS file, it enhances every aspect of the usual COMMAND.COM. Unlike *Xtree* or *The Norton Commander*, *4DOS* retains the feel and control of the DOS prompt while adding power and ease of use.

4DOS has a fully editable command line and recall of previous commands. You can start typing in a filename, hit F9, and the rest of the name will be filled in. For often-used commands, you can define aliases, which act like little batch files with replaceable parameters. I'd rate its features here as slightly above Cove Software's *PCED*, Version 1.01.

4DOS enhances the DIRECTORY, COPY, and ERASE commands and has a full-fledged file viewer. It allows multiple filespecs in a command. Intelligent wildcards let "*t*.*", for example, refer to all files with a t in their name. Its batch processor includes commands to accept single-key input and to stack keystrokes.

F1 invokes clear pop-up help, making this package accessible for nontechies. If you have EMS or swap to disk, *4DOS* takes only 4K of conventional RAM, which is less than recent versions of COMMAND.COM.

4DOS is a compelling set of integrated utilities.

List Price: *4DOS*, Version 2.0, with on-disk documentation, $35; with printed documentation, $50; shareware version, free (you can download it from PC MagNet). **Requires:** 4K free RAM, DOS 2.0 or later. Not copy protected. J.P. Software, P.O. Box 1470, East Arlington, MA 02174; (617) 646-3975.

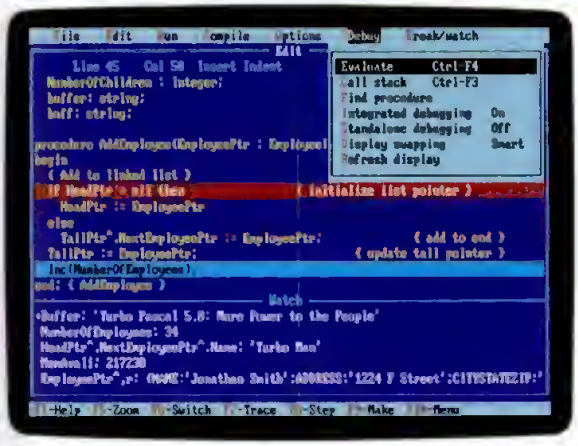
CIRCLE **431** ON READER SERVICE CARD

Through Basic training? Graduate to Turbo Pascal.

Turbo Pascal® is easy to learn, fast, powerful, and the most popular Pascal compiler in the world.

When you graduate from Basic to Turbo Pascal, you have entirely new freedoms and powers. Modern, modular programming for one. Basic doesn't encourage that. Complete control over your computer's memory is another. For more power than Basic.

Turbo Pascal's .EXE files are streamlined and fast, just like the pros'. And Pascal doesn't promote Basic programming flaws like "GOTO" that lead to spaghetti code. None of which matters as much as the spectacular difference Turbo Pascal makes to the size and speed of your programs. Basic is bigger and slower. Turbo Pascal is small and fast.



The integrated development environment lets you easily write and debug real programs.

You'll like Turbo Pascal 5.0's environmental impact

With Turbo Pascal, you're in a completely integrated environment that includes source-level debugging. You can step code, watch expressions, change variables, and set breakpoints. Edit, compile, run, and debug.

You are not alone

We're here to help—whether on CompuServe, by phone to Tech Support, or through User Groups. Borland revolutionized programming languages, made Pascal the worldwide favorite, and we're committed to supporting you. Our manuals and tutorials—unlike most others—are clear, concise, and thoroughly professional.

We also offer an extended family of Turbo Pascal Toolbox programs including source code: Runtime Library, Database Toolbox, Graphix Toolbox, Turbo Pascal Tutor, Editor Toolbox, Numerical Methods Toolbox, and GameWorks. Borland is the Pascal one-stop shop.

60-Day Money-back Guarantee.*

Turn pro for only $250 with new Turbo Pascal Professional

This special package—Turbo Pascal Professional—includes everything you need for professional programming in Pascal.

- New Turbo Pascal Version 5.0
- New Turbo Debugger*
- New Turbo Assembler*

Turbo Debugger, recent recipient of *PC Magazine*'s Technical Excellence Award in the development tools category, lets you debug *any* size program and have up to 12 views of your code. Turbo Assembler is much faster than MASM and more compatible with MASM than MASM is with itself. Turbo Pascal Professional: it's nothing but the best.

A fast look at 5.0

- Fully integrated development environment
- New source-level debugger
- 34,000 lines a minute on PS/2* Model 60
- RAM-resident context-sensitive Help
- EXE files bigger than 64K
- Demand Overlays
- EMS support
- Separate compilation by Units

Forget the Basics for only $149.95

Ready to move onward and upward from Basic? You can make easy entry to Pascal with 5.0 for only $149.95.

This is no ordinary Demo

Not one, not two, but three different demos on the same disk: Turbo C, Turbo Pascal, *and* Turbo Debugger. Plus fact sheets with technical information about each. Yours for only $4.95. Call **(800) 345-2888.**



*Customer satisfaction is our main concern. If within 60 days of purchase this product does not perform in accordance with our claims, call our customer service department, and we will arrange a refund. **Includes upgrade manual plus disks for just $49.95 (plus tax for CA and MA residents, and $5.00 for handling within the U.S. $10.00 in Canada). All Borland products are trademarks or registered trademarks of Borland International, Inc. Copyright ©1989 Borland International, Inc. All rights reserved. BI-12868

Code: MA10

BORLAND

CIRCLE 137 ON READER SERVICE CARD

dQuery: SQL and QBE for dBASE, 1-2-3 Files

PC HANDS ON

BY RICHARD HALE SHAW

Structured Query Language (SQL) and Query by Example (QBE) have become the order of the day in PC database environments. While a few PC DBMSs, such as *Paradox* and *Oracle*, have supported one or the other for years, others such as *dBASE IV* have only recently added them. Now you can purchase an SQL/QBE environment that runs independently of any database manager.

dQuery, Version 2.1, by QuadBASE Systems, is an interactive query management system. With it, you can use SQL and QBE to query *dBASE* and *Lotus 1-2-3* data files, accessing up to 32 files at a time. And you can create, modify, and manipulate the data in those files. I was able to use *dQuery* successfully to query *dBASE IV* database files as well, though *dQuery* claims no *dBASE IV* compatibility. You can even use *dQuery*'s relational join to link and query a *dBASE* database and a *1-2-3* worksheet as if they were one table.

Installation of *dQuery* is easy—just copy the disks and start the program. The *dQuery* interface uses windows and pull-down menus, so you can create and edit SQL statements in one window and run QBE in another. With the press of a key, the results of the query will appear in a separate window. Alternatively, you can use the *dQuery* report writer to format the query output.

The SQL implementation in *dQuery* is a healthy subset of IBM's relational database SQL. It provides all data-manipulation commands as well as many of the data-definition commands, including CREATE/DROP TABLE and CREATE/DROP INDEX.

In SQL, the data resulting from a query goes into a table or a view. *dQuery* provides all the commands you'll need to query the tables or views that result from other queries, allowing you to create complex, nested subqueries. However, in a rather disappointing omission, *dQuery* does not include the commands you'd need to create a new table or view from the result of another query.

If you are new to SQL, you may want to try out *dQuery*'s QBE, which resembles the QBE found in contemporary relational database systems. *dQuery*'s QBE is closely tied to its SQL: when you execute QBE, *dQuery* will create the equivalent SQL statement, execute it, and display the results. Unlike the SQL implementation, however, QBE will not let you update or delete more than one record at a time.

The *dQuery* SQL and QBE are powerful and flexible. You can use popular SQL functions such as COUNT(), AVG(), SUM(), MAX(), and MIN(); and QBE will allow the use of *dBASE* functions such as DATE(), YEAR(), and MONTH(). Comparison operators such as LIKE and BETWEEN . . . AND are also available, and you can ORDER or GROUP the output of a query in almost any form.

You can save the results of a query in one of several file formats: *dBASE* .DBF/.DBT or *1-2-3* .WKS/.WK1. You can use *dQuery* to find a set of records in a *dBASE* file and save that set to a *1-2-3* file or vice versa. *dQuery* also lets you save the queries themselves.

dQuery includes a respectable report writer. It can generate averages, totals, counts, minimums, and maximums, and it gives you the choice of previewing reports on-screen, printing them, or saving them to text files.

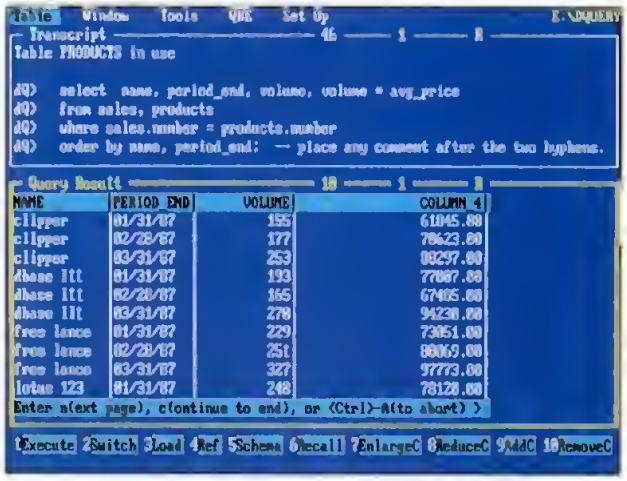
Besides the interactive version, *dQuery* comes with a batch version called *dQueryB*. With *dQueryB* you can execute QBE and SQL queries and reports from inside another program, such as *dBASE*. *dQueryB* places the results of its queries in a database file called dQUERYB.DBF. A *dBASE* program can then use this file to retrieve the query results.

dQuery/Lib, which costs more but includes *dQuery*, adds *dQuery*-SQL support to C programs. Thus, a C program can use SQL to create and manipulate *dBASE* and *1-2-3* files independently of *dQuery* or *dQueryB*. *dQuery/Lib* uses embedded SQL: you pass SQL statements to the C language functions it provides.

dQuery performs relatively well. I created SQL versions of a few of the PC Labs database benchmark tests—specifically Sort, Search, and Extract—to test the success of *dQueryB* against *dBASE IV*. I modified the *dBASE* versions to place the results of each benchmark test in a database, just as *dQuery* does, and performed the tests on an 8-MHz AT using a 5,000-record table with no indexes.

The *dQuery* sort (an SQL "SELECT . . . ORDER BY") doesn't come close to competing with a *dBASE* SORT. Alternatively, I tried sorting to a RAMdisk. *dBASE IV* ran out of room sorting a 640K file to a IMB RAMdisk, but *dQuery* was able to complete the sort and dramatically improve its performance. On the Search and Extract tests, the performance was closer, with *dQueryB* matching *dBASE IV*'s speed on the SEARCH.

Overall, *dQuery* is a powerful interactive query environment. The interface is visually appealing and easy to use, though I would have preferred hotkeys for jumping directly from one window to another. You can use *dQuery* for learning SQL/QBE or for integrating it right into an application. All in all, it is a powerful tool that will make your *dBASE* files and applications a little more "relational." PC



dQuery's windowing interface lets you move effortlessly from QBE to SQL input. You can load and execute previously saved queries.

PC MAGAZINE FACT FILE

***dQuery*, Version 2.1**
dQuery/Lib
QuadBASE Systems Inc.
790 Lucerne Dr., #51
Sunnyvale, CA 94086
(408) 738-6989
List Price: *dQuery*, $150; *dQuery/Lib* (includes *dQuery*), $295.
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: A well-designed interactive query management system for *dBASE* and *Lotus 1-2-3* users. Offers both SQL and QBE. *dQuery/Lib* allows C programs to use embedded SQL against *dBASE* files. Not copy protected.

CIRCLE 435 ON READER SERVICE CARD

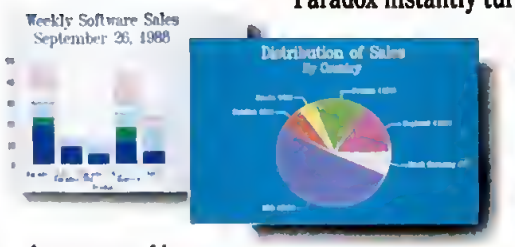
Power without pain.



Multi-table form dynamically displaying information from three related tables.

You don't have to be a programmer to have easy access to our highly sophisticated, powerful relational database, Paradox® 3.0.

Paradox 3.0 is all powerful and never painful because *it* makes all the complex inside moves, you don't. While it does the complex for you, the complexity is hidden beneath clear, natural, even intuitive pathways and patterns that make life easy for you.



With Paradox 3.0, there are no Unclears, no Unknowns. You don't need an army of in-house technical support people. And best of all, you *don't have to be a programmer* to be a pro with Paradox. It's all gain, no pain.

"Query-by-Example" for example

Use this checkmark and you're using QBE.

It's that easy. Let's say you need to know in a hurry which of your Los Angeles customers bought more than 5 pairs of white shoes. First ✓ the customer field, then type "LA," "white," and ">5," and you're done. Paradox gives you the right answer right now. And how much programming to do all that ? Zero.

If your database experience so far is limited to the flat-file type rather than relational, or even if a spreadsheet is the only program you've used before, Paradox gets you up and running immediately with just a ✓.

Record-locking and Auto-Refresh make the network safely network

Paradox has become the leading networker because it handles multi-users intelligently. If someone in your group or network has accessed a record, automatic record-locking keeps everyone else from changing it.

That way, two or more people can't change the same data at the same time. (As a bonus, Paradox also tells you *who* is using a record at a particular instant.)

Once the record has been changed by someone in the network, *Auto-Refresh* kicks in *automatically* and updates everything. Everyone in the network is looking at up-to-the-minute information.

Paradox, for the looks of things

Presentation-quality graphics are another Paradox distinction. They give you and your work the professional look.

Paradox instantly turns your tables into graphs with *one* keystroke—and in multiuser environments, with a few keystrokes your graph can show up-to-the-minute changes. Not only does everyone get the picture, they get an accurate picture.

Award-winning Paradox Family

Paradox 3.0 is the latest addition to the award-winning Paradox Family. **Paradox OS/2 and 386 received PC Magazine's BEST OF 1988 AWARD in the database category.**

✓ it out

To order a trial version of Paradox 3.0 ($14.95) or a demonstration disk ($4.95), call (800) 345-2888, extension 100. Paradox owners may upgrade ($175.00) by calling (800) 331-0877. (Please have your serial number available.)



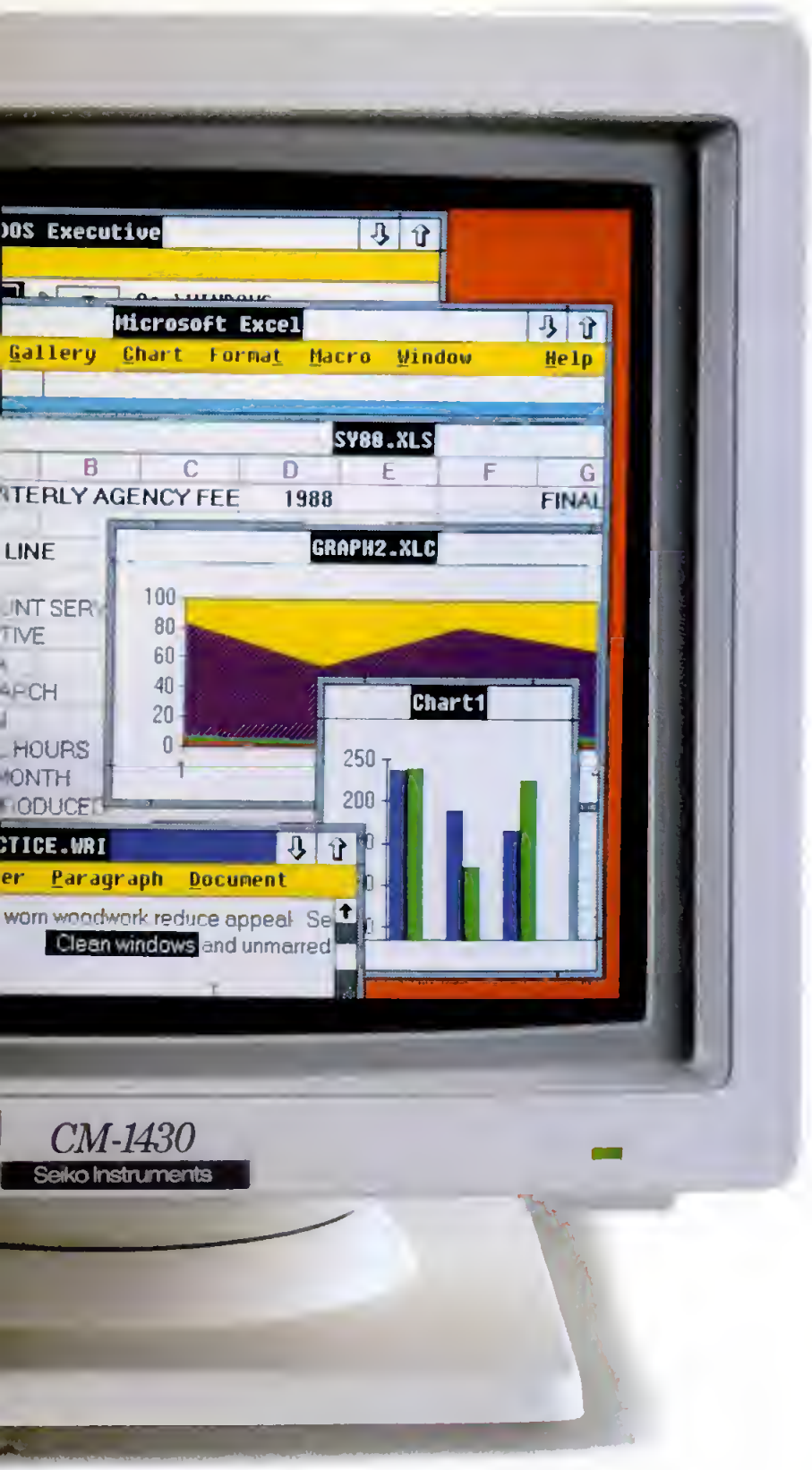
60 day money-back guarantee*

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BORLAND

Code: MP29

CIRCLE 377 ON READER SERVICE CARD



Why Our Engineers Love Smashing Windows.

When Windows looks smashing, our engineers look happy. Because that's when their hard work really shows.

Take the CM-1430 monitor, for example. Its Trinitron* screen with up to 1024x768 resolution lets you see more data, even when the active Window area shrinks. Use of one electron gun instead of three keeps colors intense, and in focus. Its cylindrical tube (rather than a round or flat one) makes screen edges razor sharp, and reduces glare. And, its tight .26mm dot pitch keeps lines sharp, type crisp.

Add obsolescence protection (compatibility with both VGA and 8514/A standards) and you're set for a stunning display of today's best software. As well as tomorrow's.

The net effect is a screen unmatched in clarity, precision, and beauty. And unapproachable in value. Give us a look. You'll see how our engineers' view of technology actually improves your view of Windows. And everything else.

Call **1-800-888-0817 Ext. 100C** for information and a dealer near you.



Seiko Instruments

Seiko Instruments USA, Inc., PC Products Division, 1144 Ringwood Court, San Jose, CA 95131, (408) 922-5900. Trinitron is a registered trademark of Sany Corporation. © 1989

CIRCLE 490 ON READER SERVICE CARD

PC UPDATE

by Gus Venditto

Dell Sets Wide-ranging Price Cuts

Prices on most of Dell's complete systems, tape drives, disk drives, and memory cards were cut significantly in March. Cuts ranged from as little as $50 off a $399 80287-8 co-processor to as much as $1,500 off a System 325 with a 322MB hard disk. The only systems exempted from the price cuts were 8088-based PCs, and 20- and 40MB hard-disk-equipped 286- and 386-based PCs. All other 286 and 386 PCs had price reductions. Two memory expansion modules were cut by 40 percent: the price of a 1MB card for Systems 220, 310, and 325 went from $799 to $479; a 2MB card for Systems 310 and 325 was reduced from $1,399 to $999. Dell Computer Corp., Austin, Tex.; (800) 426-5150.



Dell reduced the price of some System 310 configurations by $1,500.

Graphics Module Added To ACCPAC

Computer Associates International has introduced a graphics option for its *ACCPAC Plus* accounting program. *ACCPAC Plus Graphic Reporting Option* is an add-in that provides charting options from within the general ledger menus. The add-in will automatically choose a format and enter legends for graphs based on the program's knowledge base of accounting concepts like fiscal years and chart of accounts. It will sell for $149. Computer Associates, San Jose, Calif.; (408) 432-1727.

LAN Pack Talks to All Paradox Releases

Paradox LAN Pack provides a link between the various versions of *Paradox*—386, OS/2, and Versions 2.0 and 3.0—across a network. It can also boost the number of users by five in networks where one of the existing multiuser versions of *Paradox* is running. *Paradox LAN Pack* retails for $995, and it is available for $350 to users of *Paradox Network Pack* 2.0; a copy of *Paradox* 3.0 is included with upgrades from *Network Pack*. Borland International Inc., Scotts Valley, Calif.; (800) 331-0877.

Compaq Cuts 386S Prices

Compaq took $200 off the suggested retail price on each of the various configurations of the **Compaq Deskpro 386S**. The Model 1 now lists for $3,599, the Model 20 for $4,299, and the Model 40 will have a suggested retail price of $4,999. Compaq Corp., Houston, Tex.; (713) 370-0670.

Novell Boosts NetWare Gateway

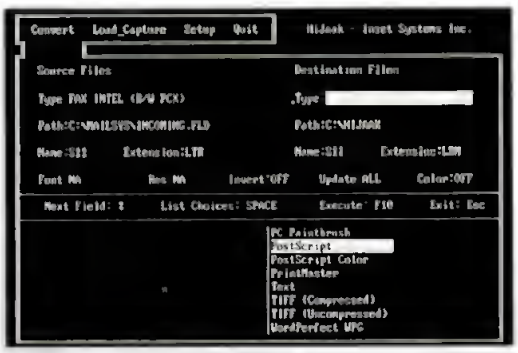
Novell has already enhanced Version 1.0 of *NetWare SNA Gateway*, which it shipped last December. Novell says Version 1.1 will boost gateway performance as much as 400 percent in some installations and will require less RAM in workstations, using 114K instead of 170K. PCs running Version 1.1 can also emulate an IBM 3179G or 3270 PCG terminal, and they will run bost graphics applications like *GDDM*, *SAS/Graph*, and *TellaGraf*. The price remains at $2,995. Version 1.1 will be free to registered Version 1.0 users. Novell Inc., Provo, Utah; (800) 453-1267.

WordPerfect And PageMaker Get Together

A filter that converts all formatting in *WordPerfect* 5.0 files when they're imported into *PageMaker* documents was released jointly by WordPerfect Corp. and Aldus Corp. The driver/filter files are available to *PageMaker* users for $15 from Aldus by calling (216) 628-2320. Subscribers to CompuServe and The Source can download the files from the *WordPerfect* support forums on those systems.

HiJaak Converts Files In DCA/Intel CAS Format

Inset Systems has added a number of fax formats to the file-conversion options in *HiJaak* 1.1B. In addition to the Lotus .PIC, CompuServe .GIF, and graphics .TIF formats that the program already converted, *HiJaak* can now read and write directly into the CAS format used by Intel's Connection CoProcessor and The Complete PC fax board. An earlier release of *HiJaak* had added the JT-Fax and Ricoh fax formats. *HiJaak* 1.1B retails for $99; registered users of earlier versions can upgrade at no charge. Inset Systems, Brookfield, Conn.; (203) 775-5866.



HiJaak has expanded its file-conversion options to include two more fax formats.

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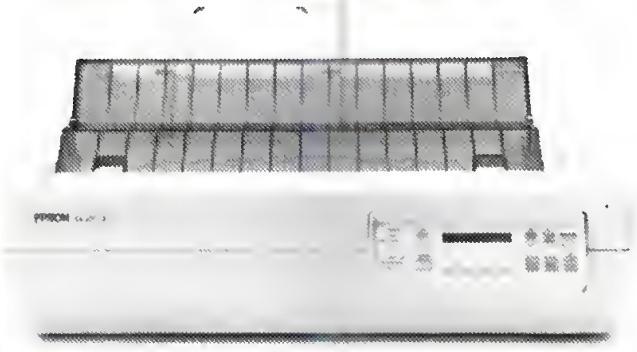
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COMMUNIQUÉS

by Bill Howard

Why America's Students Are Falling Behind– They Read Too Much

Do today's students really need fax in the dorms and on-line links to the commodities pits? Here's an excerpt from a computer Q&A column in the fall 1988 *CampusUSA*, a magazine distributed free to college students:

"*How much resident random access memory (RAM) does the PC have?* Get a minimum 560 kilo-bit to accommodate the unknown software programs that require memory to operate which you will get down the road.

"*How many expansion slots are in the computer?* Most PCs have four or five. More are better but this number is OK. You may want to add a FAX capability, an enhanced graphics adapter, or a modem to communicate with the commodities future pits in Chicago.

"*How much memory storage can you get to contain the programs and files you create?* A tough question that only you can answer. Get at least a 10 megabit hard disk, or a PC with two floppy disk slots."



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—Intelligent Environments Inc. mailing

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(Inmac catalog ad for 9,600-bps LDM Pro line driver)





Don't you wish your expansion cards slid in without removing the cover?
(Ad for Star Gate Technologies Inc. Plus 8 MC multiuser board)

Amazing Facts I

"The [Vendex Headstart Turbo 888-XT's] expanded memory of 128K allows you to use an additional computer or printer memory."

—Fordham-Scope mail-order catalog

Amazing Facts II

"Higher optical resolution is carried over to the [NeXT] display screen as well; you get an impressive 1,120 by 832 pixels to the square inch . . ."

—Traffic World *magazine, November 21, 1988*

Amazing Facts III

"One way around the proprietary-operating-system problem was to offer stand-alone workstations running Unix, a multitasking operating system in the public domain."

—BYTE, *February 1989*

Have you seen anything offbeat about the computer industry? Send submissions to Communiqués, PC Magazine, One Park Avenue, New Yock, NY 10016. Contributors receive $50 and a PC Magazine *T-shirt. Winners this issue: Tom Mignone (computer), Richard Durost (board), John Baustian (9.6 bps), Stephen Glick (kampus), Anthony Townsend (Vendex), Bill Marshall (NeXT), Bill Burd (public-domain Unix).*

Illustration: Richard Tennant



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■ BILL MACHRONE

OBJECT ORIENTED: OLD WINE, NEW BOTTLES?



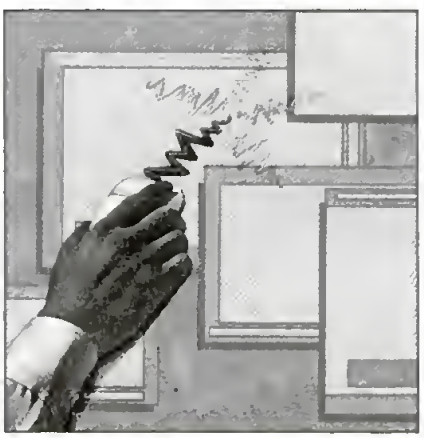
Object-oriented systems are definitely the way of the future. They will affect the way we use our PCs, networks, mainframe data—maybe even the way we think.

Object oriented. The phrase conjures up images of icons and mice and things happening magically in your computer. Everyone talks about the near future. Gus Venditto and Will Zachmann did a fine job of explaining the ins and outs of object orientation in *PC Magazine*'s March 14, 1989, issue (see "Will the World Become Object Oriented?" page 41, and "Object-oriented Tools: Panacea or Propaganda?" page 83). I won't retrace their steps. But both identified object-oriented databases (OODB) as the hot thing to watch for. You might best accomplish this by looking at the recent past.

Metaphor Computer Systems has been around since 1982. Its chairman, David Liddle (rhymes with Fidel), and its president, Don Massaro, were key players at Xerox's Palo Alto Research Center. Liddle was the product development manager for Xerox's celebrated *Star* workstation. He and Massaro developed a set of extensions to *Star* technology that would be ideal for workers lacking technical knowledge who want to retrieve, analyze, and present information. Xerox wasn't interested, so *Metaphor* was born. Liddle is one of those eminently quotable people who have a take on just about everything. On the file-server-based database engines: "Real databases learning to be small." On *Metaphor*'s technology exchange with IBM: "It's only dangerous to live between the giants if they're made of a hard substance." On his company's intended audience: "Users of the biggest databases tend to be the ones farthest from the computer. They're strongly oriented to the syntax of the data, not to the machine."

And therein lies the magic of *Metaphor:* a collection of deceptively simple, object-oriented tools that gives you analytical power that makes you want to throw rocks at *dBASE*. Today *Metaphor* is delivered on proprietary workstations networked to a file server, which in turn may be networked to one or more host computers. The workstation is a dramatically styled unit with infrared mouse, keyboard, and keypad. Fully 40 percent of *Metaphor*'s users never touch the keyboard. They don't have to. A *Metaphor* user can produce just about any analysis imaginable simply by pointing at objects (data), connecting them with the mouse in whatever way the user wants to see them, then pointing the results into a spreadsheet, graphing package, or report generator.

Liddle believes that most of today's database packages try too hard to be all things to all people, thereby getting bogged down in needless complexity. *Metaphor* doesn't attempt to build database engines, but it provides the tools to get at everyone else's. *Metaphor*'s approach is what sets it apart. It's simply the easiest query and analysis system I've ever seen or used. Huge, complex, relational databases kneel before *Metaphor*'s retrieval technology, and the nontechnical user is none the wiser.



Metaphor gets the actual information from the database by generating SQL searches. Proficient users can open a window and edit the SQL code for even more power and flexibility. Any task or series of operations that you set forth for the system can be saved in a procedure, which *Metaphor* calls a capsule. Capsules can call other capsules. Users can keep them private or make them available for general use. Capsules are more than canned applications, too. *Metaphor* provides an input tool that lets users enter variables, constraints, or ranges at runtime. Variables within a capsule can be local or global.

THE IBM CONNECTION Why should you care about this proprietary system, other than that it's already in use by more than 80 of the Fortune 100 companies? Because IBM cares enough to have bought the rights to offer *Metaphor* under OS/2 Extended Edition. It'll run on 80386-based PS/2s later this year. EE as it exists isn't all that impressive. With a user interface and tools like *Metaphor*'s, however, it'll blow most of the competition into the weeds. You've heard, and perhaps asked, "Why should I switch to OS/2?" *Metaphor* is a reason.

Illustration: Sandra Filippucci

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CIRCLE 140 ON READER SERVICE CARD

■ **BILL MACHRONE**

LIFE IN A CAPSULE The purists among you may be asking, Is this really object orientation, or is this just a pretty face on a traditional relational database? Rest assured that *Metaphor* is indeed object oriented. It blurs the lines between data and programs. Granted, *Metaphor* is not the retrieval engine. That's still a relational database that you talk to through SQL. But you can do everything to it, including build and maintain it, with fully object-oriented tools.

In fact, it's impossible to distinguish between using the tools for a casual query and using them to build an entire application. If you like what you've done, you just pull the pieces into a capsule object, give it a name, and distribute it to your fellow users. You can always go back and gussy it up with some user-entered variables or whatever else is necessary to generalize it. Users of the system say that they'd have to wait years—and spend thousands per report—to get the same thing from their conventional data-processing systems. Even fourth-generation languages can't crank out applications as quickly as *Metaphor*.

TAIL WAGGING *Metaphor*'s market potential makes it strategically important to IBM. Liddle says that there's no point in doing a Presentation Manager version of *Metaphor* until the Presentation Manager itself is rewritten in 32-bit code. The existing constraints are just too great. Consequently, there is greater pressure than ever for Microsoft not only to rush the 386 version of PM, but also to modify OS/2 to accommodate *Metaphor*. IBM (and Metaphor) would like to see changes in OS/2 so that *Metaphor* capsules will be able to launch and interact with OS/2 apps. That's not possible at the moment, so the first version of *Metaphor* will doubtless be a contradiction in terms, an ill-behaved OS/2 application.

Microsoft, meanwhile, has its own ideas about how object orientation should be accomplished under OS/2. It's been widely reported that BASIC is under fundamental revision to make it object oriented, capable of controlling other programs and the central control program for both *Windows* and the OS/2 PM. Does this signify a split in direction between IBM OS/2 and everyone else? Time will tell. PC

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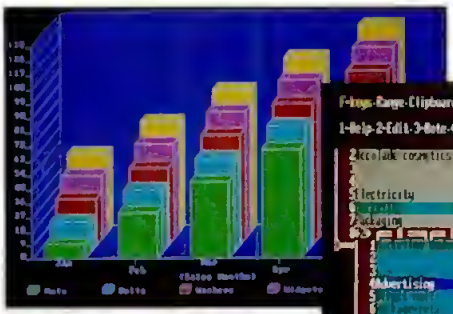
Version 2.0 of Lucid 3-D is more than a bag of new features. It's a masterwork! The original Lucid 3-D captured the industry's attention with its simple to use, yet remarkable three dimensional capabilities. Last year's winner of *PC Magazine's* Award for Technical Excellence, Lucid 3-D is fast, even on a 256K, 8088 computer. Lucid 3-D is the super spreadsheet that doesn't require a super computer!

DacEasy is proud to produce this leading edge product. Its innovative design allows first time users to learn quickly while power users of other spreadsheets move to our advance features effortlessly. The Lucid 1.0 featured pull-down menus, optional instant command keys, multiple windows, a notepad in every cell, optional ram, total mouseability and both a reference and tutorial manual. These features alone make this spreadsheet a must buy at only $99.95. It's no wonder Lucid 3-D was voted Editors' Pick for 1988 by *Home Office Computing*.

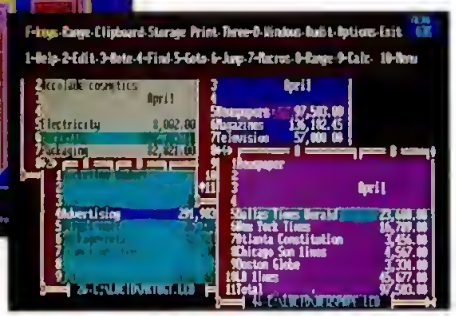
"Lucid is a spreadsheet for our times It is technical tour de force in an era that seems to have forgotten how to write tight code." PC MAGAZINE

"You might think that a RAM resident spreadsheet would necessarily be limited in features. We found that Lucid 3-D is anything but limited in power." INFOWORLD

"Lucid 3-D is a package that could alter the face of future spreadsheets. It offers residence, multiple windows, colour, mouse support and rapid execution." PC USER



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*PC MAGAZINE EDITOR'S CHOICE 2/28/89

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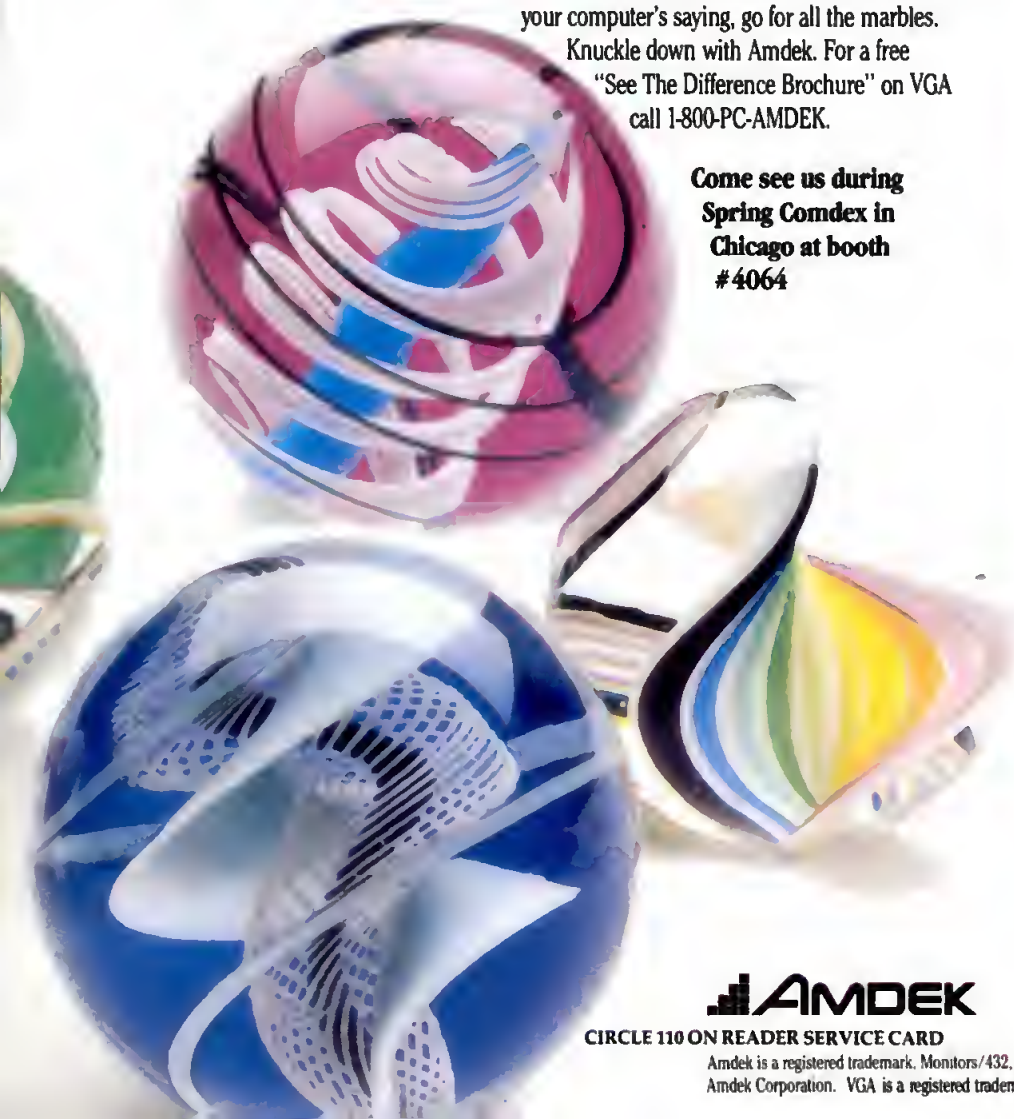
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■ JOHN C. DVORAK

THE DEATH OF PROGRESS



The 8088 dead? The 80286 dead? Don't kid yourself. While some people keep writing code for the wimpy 8088, Dvorak debunks the mystique of upward compatibility.

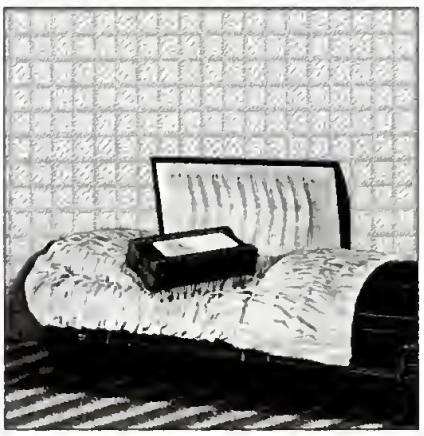
Nah, John, the 586 will knock them all off. Seriously. I don't disagree that the 486 will have the power to kill the 286, but it may not be needed to accomplish that task. Don't you think the 286 chip will be pretty well relegated to the low end before the 486 is in wide use? And, obviously, you are right that the 486 will choke the 386, but in what time frame? Are you anticipating that the 486 will be functioning over the whole market spectrum within the next couple of years? I just don't know enough about its speed, power, development cost, or manufacturing cost to guess. What will be its memory-addressing range? Its higher clock speeds? Its faster operation at comparable clock speeds? Its built-in multitasking? Its fresh morning coffee? Will it be cheap enough to be used in single-user machines in the early part of its life cycle, or will that have to wait until the 586 has forced its price down? Give us some more words to mark.—George Figge arguing a point on PC MagNet.

One recurring topic of conversation on the CompuServe-based PC MagNet is which chip will achieve dominance and hegemony in the PC world. People fret on the subject until all hours of the night. Is the 286 dead? Yes. No. Is the 386 already dead? Who knows?

One thing's for sure—as long as coders keep writing code for the wimpy 8088 chip, and as long as people persist on buying this old clunker, we aren't going to see the death of any chip. The lowest common denominator has us by the short hairs.

Even the boys at Taiwan's biggest clone maker, Acer, told me that they were shocked by the demand for 8088/86-based systems last year. They had figured over 2 years ago that 1987 would be the last year of the 8088. 1988 was bigger than ever, although the high-performance chips have finally taken the majority of the market. But what difference does it make which chip you use if there is no code of any consequence written for the newer chips and their capabilities? It's ridiculous. It's like having a Volkswagen equipped with a jet engine. To make matters worse, there's a 55-mph speed limit.

The 640K memory limitation is the albatross around our necks, and there's nothing we can do about it as long as coders keep writing for the lowest common denominator. Let's face it, the number of products available specifically for the 286 and the 386 is a laugh. Oh, there's *Paradox 286*, there's OS/2. Big deal. Then we have *386-to-the-Max*, *DESQview 386*, and *VM/386*—products designed to cheat the 640K barrier in one way or another. In a pure 386 environment—if it began fresh today, with no history and no 8088 around its neck—these products wouldn't exist.



Progress takes place only when technology makes a break from the past. The big jump from the old CP/M clunkers (with their 64K limits and Z-80/8080 code base) to the IBM PC-DOS took place because code for the 8080 generation of Intel chips isn't compatible with the 8086 generation. If the 8086 chip ran 8080 code, we'd still be using CP/M and moaning about the 64K limits. As silly as it sounds, that's exactly what buyers of a new Commodore 64 face today—as do the die-hard CP/M users who refused to upgrade.

FUTURE BLOCK But upward compatibility will be encouraged by the software companies who want the broadest base of users with no concern for the future of the technology. Who wants to recode? These guys will continue to code for the 8086 and continue to live with more and more stopgap modifications, such as LIM 4.0, to make use of more memory. Old Z-80 diehards have found a way to address 128K too. Meanwhile, the 8086 code perpetuates the lowest common denominator. I expect to see an under-$400 hard-disk-based 8088 computer. That will keep the 8088 alive forever, forcing us to sit here mired in the muck of low performance.

What's dead is not the 8088 and 80286, but the future of PC-based computing if this continues much longer. We need a whole new chip that can't run 8086 code. We need it quickly.

Illustration: Sandra Filippucci

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CIRCLE 381 ON READER SERVICE CARD

■ JOHN C. DVORAK

INSIDE TRACK

The AX computer: A genuine threat from Japan.

There's an old college football fight song used by both the **University of California** and Stanford. It goes: "Give 'em the ax, the ax, the ax. Where? Right in the neck, the neck, the neck." The chant refers to a controversial ax that is given to the winner of the Big Game each year. Japanese and Taiwanese **clone makers** may want to use this fight song thus: "Give 'em the AX, the AX, the AX. Where? Right in the NEC, the NEC, the NEC." This modified chant refers to the **controversial AX machines** now flooding the marketplace in Japan and threatening NEC's **stranglehold** on the Japanese market for desktop computers. **Microsoft,** curiously, is the force behind the AX standard. It's such a big fish that Microsoft has hooked that we can expect to see the AX standard incorporated into the next wave of domestic XT/AT/386 designs, possibly by year's end. The fish is so huge that the boat may be swamped and the domestic clone makers all **doomed** to a burial at sea.

Interesting Fact Number One: NEC currently dominates the market there with an 80 percent or higher market share. The NEC models are proprietary machines that would sell **zilch units** in the U.S. As long as NEC dominates the Japanese scene, Japan will be **no threat** to our desktop computer industry.

Enter the AX machine, designed by a club of hungry Japanese companies (orchestrated by Microsoft) and targeting NEC's dominance. This is no EISA charade. The AX machine is designed around MS-DOS and a special architecture and BIOS incorporating the Japanese Kanji character set along with the English character set. Special graphics cards such as the **J-EGA** are used for display. The AX standard is a **superset** that has, at its core, the AT architecture. If the AX machines become the standard in Japan, then watch out, Mr. Dell.

Most of what we've seen from the Japanese (Toshiba and NEC portables, plus other, less-successful systems) have not reflected a typical **Japanese market grab.** Toshiba America is more of an American enterprise than a Japanese one. You have to remember that the Toshiba machines were designed in the U.S. and not in Japan. The usual Japanese strategy is to design and build a product for the Japanese market, and then, when the market is saturated, **swamp the world** with the overflow. (See the 1985 book *Kaisha—The Japanese Corporation*, by Abegglen and Stalk.) We've seen the phenomenon in cars, TVs, home electronics, machine tools, and other markets. The desktop AX machine is the **key to the next invasion.**

Interesting Fact Number Two: Mitsubishi, Alps, Oki, Canon, Kyocera, Sanyo, Sharp, Acer, Daido Nihon, and Mitsui are already shipping AX machines. There are expected to be over **100 models of AX machines** released by the end of the year. Even NEC is readying a system or two, reluctantly. The AX standard requires at least a 286 chip, so most of these machines are pretty **powerful.** Canon is showing a **lunch-bucket portable** (DX-20P) with a 20-MHz 386, 40-meg hard drive, and a four-tone gray-scale LCD that is tilted by a small motor in the computer. Unisys is expected to be the first American firm to drop an AX machine into the Japanese market.

Interesting Fact Number Three: The American firms in the club of 300 would-be AX computer makers (and a few AX-sympathetic software firms) are an interesting and **unexpected** group that includes: AST, **Apollo,** NCR, Data General, Pick Systems, **Prime,** Microsoft, Memorex-Telex, Hewlett-Packard, Unisys, **Lotus,** and Unisys-Nihon (a Unisys-Mitsui joint venture).

Interesting Facts Score: One interesting fact for NEC, two interesting facts for AX. **The winner: AX.**

This **AX madness** will not be anything like Microsoft's **MSX fiasco.** The MSX standard, you may recall, was going to allow the Japanese to standardize on a Z-80 and somehow rekindle the cold embers of a home computer market. It never happened despite a **tonnage** of hoopla and **unending rosy predictions.** It died a **miserable death** just as I was being told that MSX-II would be the ticket.

MSX was a counter-revolution, though, and doomed to failure. It was incompatible with the bulk of the machines being sold. The AX is a superset machine. Whatever you can run on your XT or AT will run on an AX. The early signs indicate that the Japanese are going for these machines in a big way. Japanese manufacturers **will soon produce machines like crazy,** thus forcing themselves to dump their excess capacity and aging inventory (dirt cheap) into the U.S. market.

There is not one clone maker unaware of the **destructive potential** of this scenario. This is why companies like Everex are introducing machines with 88000 chips. This is why Compaq is trying to stay as high-ticket and cutting-edge as possible. This is why IBM is changing its low-end strategy. Most of all, this is why the next big market all the manufacturers are eyeballing is for the so-called **personal workstation.** They are all ready to **pull the plug on the PC business** when the surge of lowball Japanese machines hits the shores. Some companies are **angling for protectionist legislation.** The fiasco over memory chips makes these pleas seem like crying wolf, though, so nobody expects any help. The next words you hear in the computer business may be "Tora, Tora, Tora!" PC

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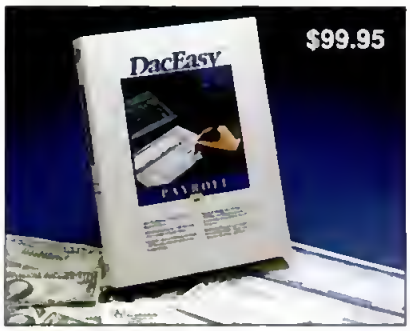
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PC MAGAZINE EDITOR'S CHOICE
September 15, 1987

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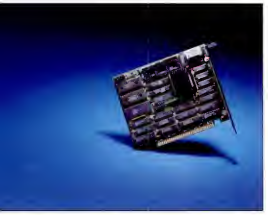


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■ JIM SEYMOUR

MORE ON PCs AND POSTSCRIPT PRINTERS



PostScript support in PC programs is still thin and incredibly uneven. A new utility program offers some relief. It lets you use your familiar DOS applications with that fancy laser printer.

In the previous issue I lamented the serial-only printer connections of the otherwise superb Apple LaserWriter IINTX. Probably the best PostScript-controlled desktop laser printer ever built, the IINTX continues Apple's pigheaded serial-only mind-set, burdening PC users with a data transmission system better suited to clunky old teletypewriters than to modern high-speed laser printers.

The LaserWriter IINTX has in common with a whole class of smart new printers its most important features: a controller board built around Adobe's PostScript page-description language and a slew of high-quality fonts from Adobe, which are built into the machine in 1.5MB ROM chips.

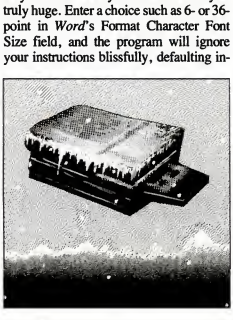
Although we think of page-description languages as desktop publishing tools, once you've used a PostScript printer with standard DOS applications, you won't want to go back to what you were using before that PostScript laser printer came along. That is, assuming you actually *got* your standard DOS application running with the printer. Because PostScript support in PC programs is still thin and incredibly uneven.

Take Borland's *Quattro*, for example. While it can drive a PostScript printer for graphics output, it can't print simple text-only worksheets easily on that same printer! What are we supposed to do, Philippe? Use a cheap dot-matrix printer for the bulk of our work—those rows-and-columns printouts—then print the occasional graph on our $4,000-to-$7,000 PostScript laser printer?

The problem isn't limited to Borland. Lotus has only recently gotten around to supporting PostScript printers in *1-2-3*. You get a PostScript driver on the disk in the *ValuePak*, which Lotus is giving away in an attempt to keep *1-2-3* users happy till the long-promised Release 3.0 ships this summer.

Even Microsoft—which showed in the *Windows* drivers it shipped with *PC Excel* that it understands very well how to support PostScript—provides halfhearted (or halfminded) PostScript support in *Microsoft Word* 4.0.

You can choose among just six sizes of type for the Adobe fonts in *Word* 4.0: 8-, 10-, 12-, 14-, 18-, and 24-point. And that's despite the fact that one of the great benefits of PostScript outline fonts is that they're continuously scalable from tiny to truly huge. Enter a choice such as 6- or 36-point in *Word*'s Format Character Font Size field, and the program will ignore your instructions blissfully, defaulting instead to the nearest value from among its meager six sizes.



We don't expect WYSIWYG displays from this generation of software, Microsoft—but we do expect the ability to use our expensive, intelligent PostScript printers fully.

The best way to use a PC application with a PostScript printer is to try the PostScript driver provided with the program—if there is one. But don't be surprised if that driver is pretty lame.

HERE'S HELP The semi-good news for those of us who've made the investment in PostScript laser printers (or in any of the many PostScript-controller upgrade boards now appearing) is that a new utility program lets you use your familiar DOS applications with that fancy laser printer. You'll be limited in what you can *do* with those printers—no utility is a true replacement for a PostScript driver designed specifically for a given applications program—but *Trading Post* is certainly better than nothing.

Trading Post, from Laser Tools ((415) 843-2234), is a $79 TSR that in return for 7KB RAM lets you create PostScript printer setups on virtual (and thus nonexistent) LPTx ports. Each imaginary printer port is assigned a set of output specifications. *Trading Post* watches for data sent by your applications programs to all printer ports.

Data sent to LPT1, to which the (real) PostScript laser is connected, is assumed to be already formatted with PostScript commands, and it isn't meddled with. Data sent to what Laser Tools calls the oth-

Illustration: Sandra Filippucci

■ JIM SEYMOUR

er "managed" ports is reformatted with PostScript commands, according to the page-layout and type-font criteria you've assigned to each of those virtual ports.

For example, you might set up LPT2 as an imaginary PostScript printer that prints sideways in 6-point Courier on 8½- by 14-inch legal-size paper, with 1-inch margins all around. LPT3 might be a second imaginary PostScript printer, set up for 12-point Times Roman type, with 1¼-inch margins.

(*Trading Post* can also print to virtual COM*x* ports, but problems with the way some programs format data for serial ports make that risky.)

TRADE-OFFS The big problem is that while *Trading Post* allows you to tell your PostScript printer to use, for instance, 12-point Helvetica italic type, unless your *application* knows how to handle 12-point Helvetica italic (which is a proportionally spaced font), your output may be all wrong.

Decimally aligned columns such as those used in spreadsheets, for example, will be askew. And even straight text material from a word processor won't have the right line breaks, page breaks, and so on, unless that word processor "knows" how to display and then print 12-point Helvetica italic. And if it *does*, then chances are that it already supports PostScript directly. So, even if you get *Trading Post*, you'll probably wind up using it to print almost everything in monospaced Courier.

■ We don't expect WYSIWYG from this generation of software, but we do expect to use our expensive, intelligent PostScript printers fully.

Trading Post lets you assign only one font to each file sent to the printer, negating another of the great advantages of PostScript printers: multiple typefaces within a document.

Nevertheless, *Trading Post* is a useful addition to the PostScript user's tool kit. It can help you get documents that are better-looking, if not necessarily fancy, while you wait for the publishers of your software to deliver PostScript drivers. PC

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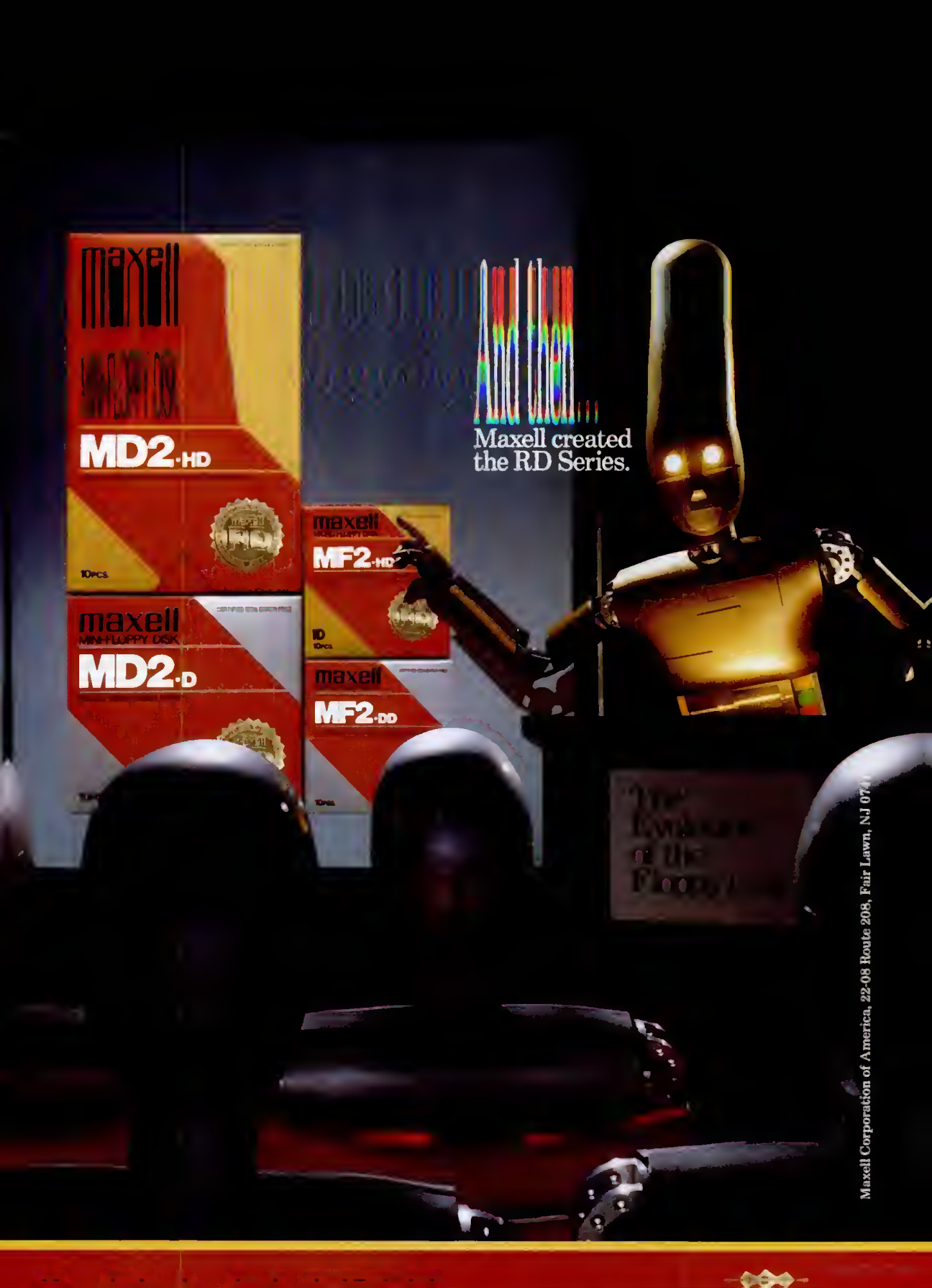
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■ WILLIAM F. ZACHMANN

"IF YOU CAN'T BEAT 'EM, SUE 'EM!"



The current crop of lawsuits in the personal computer industry may end up destroying the intense competition that has inspired rapid advances in information technology.

"If you can't beat 'em, sue 'em." That's beginning to look like the operating principle of a growing number of vendors in the personal computer industry. The list of companies trying to protect established positions with legal action instead of product innovation is getting longer. It is not a trend that bodes well for users or for the industry.

Lotus, Apple, and Ashton-Tate are three of the most prominent vendors trying to eliminate competitors in the courts rather than outdoing them in the marketplace. These vendors are not alone in doing so and are likely to be joined by others in the future.

"Intellectual property rights" form the underlying legal foundation for the increasingly litigious atmosphere in the industry. Patents, copyrights, and trademarks give an individual or a firm the right of ownership over what amounts to ideas (patents), expressions of ideas (copyrights), symbols (trade marks), and the like.

LEGAL RELICS Laws regarding intellectual property rights significantly predate computers and the emerging "age of information." For the most part, they were evolved during the Renaissance and the early days of the printing press—long before the technologies that are now reshaping the nature of life on the planet were conceived.

Current cases involving personal computer hardware and software require the application of these laws to a very different set of technologies. In the context of modern information systems, laws governing intellectual property rights require substantial reinterpretation, since many current situations were unimaginable when the laws were written.

Such reinterpretation, while not uncommon in the history of law, is occurring in a particularly intense and concentrated form as the many suits currently pending in the industry are decided. This introduces an unusual degree of uncertainty over how some of the more important cases are likely to be decided. What's frightening is that some of the outcomes could conceivably have dramatic effects on the future of the industry.

BROAD CLAIMS At bottom, however, the fundamental question running through all of these cases is how broadly or narrowly the domain of intellectual property rights should be be defined. In each case, the plaintiff—by asserting an intellectual property right—is in effect claiming that a broad class of instances falls into the domain of protected intellectual property. The defendants, on the other hand, are denying that claim.



There is a very real danger in all this. It is that the courts may, by defining too broadly the domain of intellectual property rights, destroy the atmosphere of intense competition that has made the rapid rate of advance in information technology possible in recent years.

If the broad claims asserted by the plaintiffs in pending suits were accepted, this rapid progress would be brought abruptly to a halt. A dark curtain would be drawn over the industry, bringing about a return to the semimonopoly markets characteristic of the past world of proprietary mainframes. The personal computer "revolution" of the 1980s would become merely a temporary aberration, like the Czechoslovakian "spring" of 1968.

NARROW GROUNDS Chances are, that isn't going to happen. While the Lotus lawsuit may have some chance of success, Apple's and Ashton-Tate's do not look very promising. And even if they do succeed, their victories might be on sufficiently narrow grounds to do no serious harm. Still, even the possibility that the broader claims asserted in these suits might be accepted should be cause for concern to those interested in gaining the maximum advantage to society from modern information technology.

Consider, for example, how different things might be if computer algorithms or

Illustration: Sandra Filippucci

■ WILLIAM F. ZACHMANN

computer languages were subject to copyright laws. Many (perhaps most) of the programs presently in use would never have been developed. And software would be much more expensive than it is today, since all sorts of royalties would be required for even the most basic applications.

Copyright laws are based on the premise that an author has a more or less natural property right to a work he or she created. Applying these laws to computer programs or graphical user interfaces involves a significant extension of that premise. Recently, plaintiffs hoping to redefine the boundaries have tried to extend cases based on copyright laws into domains previously subject only to patent laws.

But patent laws have a different premise from copyright laws. They derive their justification from their supposed benefit to society. The gist is that, by granting a license for an idea in exchange for requiring the publication of that idea, society benefits doubly. The first benefit is that innovation is stimulated by the promise of a protected return on a successful invention. The second is that, by taking the idea out of the hidden realm of trade secrets and into the light of publications, it becomes available for others to use indirectly in developing better ideas and products to offer society as a whole.

■ If the courts define intellectual property rights too broadly, a dark curtain will be drawn over the industry, and the PC "revolution" will become merely an aberration.

If the courts allow intellectual property rights to become a tool that enables established vendors to stifle competition and inhibit innovation, then one of the fundamental justifications for these laws—that is, their benefit to society—will be violated. Let's hope the courts are wise enough not to let that happen.

If they are not, it's up to those of us who want to continue enjoying the benefits of intense competition and rapid innovation to press decisively for legislative action to ensure that the public interest, rather than that of a few large and increasingly threatened vendors, is well served. PC

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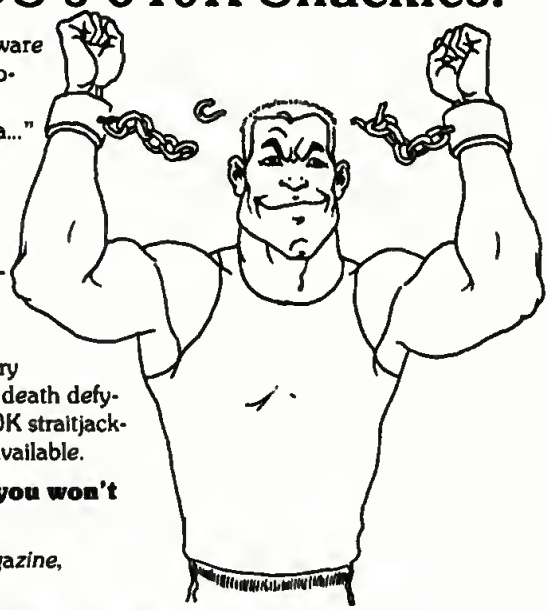
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■ STEPHEN MANES

EVERYDAY THINGS: GOOD DESIGN AND BAD



You can tell good designs from bad ones the moment you see them. The reason there are so many of the latter is that designing even simple things is anything but simple.

Here's Sharp's Wizard—a cute little suit-pocket-size electronic appointment book with strong hooks into the DOS world I live in. So what's the catch? Why won't I be carrying one behind my tattered lapels?

Because the keyboard is utterly unusable, that's why. Although advised by knowledgeable citizens that a horizontal layout and QWERTY keyboard would make a lot more sense, the Sharp minds decided to squeeze the keys in vertically and alphabetically, thereby sabotaging their product. Bedazzled by focus groups' claims that "We want it vertical, so it can fit into a coat pocket," the Sharpsters failed to notice that the layout could simply have been rotated 90 degrees. Besides, they must have reasoned that executives aren't typists: Doesn't an ABC layout make sense for the fumble-fingered?

EVERYDAY THINGS In a word, no—as a quick perusal of Donald A. Norman's thought-provoking, often hilarious book *The Psychology of Everyday Things* (Basic Books, 1988; $19.95) would have told them in a pithy photo caption: "Products with Alphabetical Keyboards. Even though several experiments show that these are of no use to novices and detrimental to experts, every year designers plunge ahead and foist yet another alphabetical keyboard on us. Even if you manage to learn one, you will not have learned to use all the different ones."

Real-world confirmation? Microlytics' little pocket standalone *Word Finder* thesaurus, aimed at a very broad market, recently switched from an alphabetical layout to QWERTY. Even though its keys are tiny, there's no guesswork about where to find them. If you're familiar with standard keyboards, the frustration level goes down to zero; if you aren't, the QWERTY layout incurs virtually no performance penalty. Everybody wins.

NO-NONSENSE APPROACH Norman is professor and director of the Institute for Cognitive Science at the University of California, San Diego, and his personal cognition of user interfaces makes his book required reading for anyone thinking about product design. It's by far the broadest and clearest approach to the subject I've seen, setting out an entire philosophy of the way things ought to work, with examples ranging from doors, stoves, refrigerators, and light switches to cars and computers. The goal: Design that makes sense, not some aestheticized "design" principle that hides clumsy products behind sleek "sculptural" exteriors.



Illustration: Sandra Filippucci

This no-nonsense approach blasts the cobwebs off traditional wisdom. "Alas, even the best manuals cannot be counted on; many users do not read them," Norman notes at one point. "Obviously it is wrong to expect to operate complex devices without instruction of some sort, but the designers of complex devices have to deal with human nature as it is."

As a particularly telling example, Norman cites a kid-oriented Nintendo game system. Its instructions read, "CAUTION!! ALWAYS MAKE SURE THAT THE POWER SWITCH ON THE CONTROL DECK IS OFF BEFORE INSERTING OR REMOVING A GAME PAK!!" The professor lectures: "In the absence of any forcing function, the instruction is almost universally disregarded (if anyone even knows about it). If order is important, there should be a forcing function." In other words, make errors impossible or difficult *by design* rather than by exhorting and trusting users to do things correctly.

HUMAN ERROR "People make errors routinely," Norman reminds us. Good design should insulate users from such disastrous mistakes as inadvertently erasing files. The way DOS merely deletes erased filenames from the directory rather than trashing files in their entirety (thereby making possible the rescue magic of such programs as *The Norton Utilities*) is the kind of cushion against catastrophe that Norman approves of; on the other hand, he'd probably suggest that a recovery

■ STEPHEN MANES

mechanism be built into the operating system itself.

Norman urges the copious use of feedback. There's nothing worse than pressing a key and having to wonder whether the computer got your message. It's not enough for a program to accept your command and then blithely spend the next 10 minutes churning out a report. Some sort of response—at minimum an acknowledgment of precisely what command you entered—should occur immediately so that you understand what's going on.

Norman expands this idea into the concepts of "mapping" and "visibility." The consequences of pointing with a mouse and clicking its button can be made obvious; what the same action will do if you also hold down the Shift key is rarely as clear. In general, the more obvious and unambiguous the result of an action will be, the better for the user.

Norman treats at length what he calls "the tradeoff between knowledge in the world and in the head." Knowledge in the world is highly visible and strongly evident—for example, an electric range control whose switches are positioned to mimic the positions of the burners. Knowledge in the head is what you have to remember without external clues—for example, your bank card passwords. With computers, knowledge in the world is typified by menu-driven interfaces like the Macintosh's; a command-line interface like good old DOS requires plenty of knowledge in the head.

HEAD VS. HEART The advantages of knowledge in the world are ease of learning and initial ease of use. The advantages of knowledge in the head are efficiency and power—you can skip right off to do what you need. Both are appropriate in their place. But there's little wonder that Norman recommends bigger doses of the "world" view and admires many things about the Mac. Anyone who's ever had to impart to a novice the knowledge in the head (Was that parameter /s or /f?) needed to make DOS work will sympathize.

In ranging across the world of design, Norman covers such quirky nonstandard products as VCRs, telephones, and faucets. Norman believes in the importance of standards but fully acknowledges the importance of their timing. Standardize too early, and a technological infant like CP/M (or DOS, OS/2 programmers would say) may dominate the world with its shortcomings. Delay standardization too long, and agreement may become impossible.

Still, a recognized yet possibly inferior standard such as the QWERTY keyboard can become so powerful by virtue of its universality that there's no real benefit in trying to unseat it with something obviously, but only marginally, better. Are you listening, wizards? PC

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MONITORS FOR VGA AND BEYOND

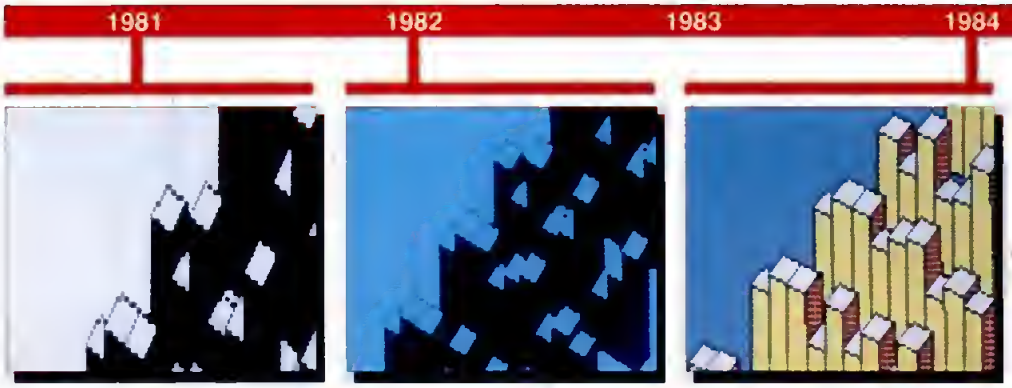


Today's monitors range from monochrome to Super VGA, displaying yesterday's and tomorrow's video standards.

THERE'S NO WAY AROUND it: '90s-era computing will be built around graphical user interfaces. To properly view a GUI, it's generally agreed, VGA (video graphics array) resolution is a must. At least VGA, that is—for there are some who think that even VGA resolution isn't high enough for graphics environments. If you've been paying attention to the tumultuous graphics market, you're aware that an industry coalition is pushing a competitively priced, higher-resolution upstart dubbed *Super VGA;* it's also called extended VGA and VGA plus. Which is why, if you're in the market for a monitor, it may not be a bad idea to consider a multiscanning monitor.

The 12- to 14-inch multiscanning monitors reviewed in this article are all capable of displaying the 640 by 480 resolution of the reigning analog VGA standard introduced 2 years ago with IBM's PS/2. If the Video Electronics Standards Association (VESA; see the sidebar "VESA: Looking Forward to a New Standard") succeeds in gaining Super VGA the support of a sizable number of software vendors (Super VGA drivers for *Windows, GEM, Symphony, AutoCAD,* and *PC Paintbrush* exist), all 19 of these monitors let you display 800- by 600-pixel resolution. But if you're interested in extremely high resolution—namely,

The Resolution Time Line: Additional Pixels Enhance Quality



CGA

CGA (Color Graphics Adapter) was one of the two display adapters IBM introduced for its original PC. The other, MDA (Monochrome Display Adapter), was less expensive; it offered higher resolution (720 by 350 pixels) but could display only text—no more than 25 lines of 80 characters each—in a single color. CGA offered a palette of 16 colors, with two modes: 320 by 200 resolution with four colors and 640 by 200 with two colors. By 1982, power users were using both adapters, MDA for text and CGA for then-new *Lotus 1-2-3* graphics. Both accepted TTL (transistor-to-transistor logic) signals.

HERCULES

The Hercules Graphics Card was invented by Van Suwannukul (founder of Hercules Computer Technology) so that he could use a standard PC and monitor to produce his doctoral thesis using his native Thai alphabet. This TTL adapter was capable of generating monochrome graphics with 720 by 348 resolution. It was the only type of adapter to become a standard though not promulgated by IBM. Sales took off after Lotus supported Hercules adapters in Release 1A of *1-2-3*.

EGA

Although today the standard EGA configuration is a card with 256K of DRAM, able to provide 16 out 64 of colors at 640 by 350 resolution, the EGA card that IBM originally offered had but 64K, enough to display only 16 colors at 320 by 200 resolution. Before long, the optional 192K memory addition was considered mandatory even though it nearly doubled the cost of the card. Competing EGA board makers began offering 256K as a standard configuration.

At the same time it introduced EGA, IBM released PGC, the Professional Graphics Controller. With its 640 by 480 resolution, the PGC card was slow and expensive, and it failed to become a graphics standard. While EGA required TTL signals, PGC needed analog ones.

the noninterlaced 1,024 by 768 pixels that Compaq is now promoting—only one of these monitors, NEC's MultiSync Plus, will fill your needs.

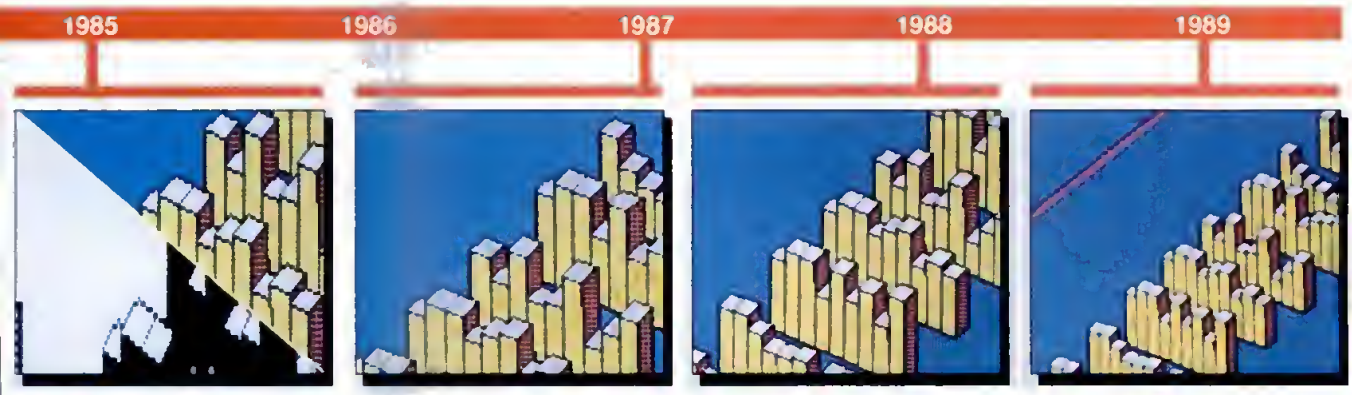
Besides giving you upward compatibility, these monitors can lock into older, digital (TTL) standards: all can display CGA, EGA, and PGC images, and the vast majority can show MDA and Hercules images, as well. A few even offer the ability to plug into standard composite video signals, such as those used by VCRs.

FREQUENCY RANGE To display graphical images, a monitor must be able to handle the two synchronizing frequencies used to form them: the horizontal scanning frequency (the rate at which one line is drawn across the width of the screen) and the vertical scanning frequency, also called the refresh or frame rate (the rate at which a complete screen is filled with image).

Each graphical standard requires a different combination of these scan rates; multiscanning monitors are so named because they can scan a range of horizontal and vertical frequencies.

60 Hz (60 refreshed images per second) is the VSF (vertical scanning frequency) used by most of the video standards—including EGA, VGA, and Super VGA—because when a display screen with short- or medium-persistence phosphors is filled at this rate, its image appears to be continuous. The MDA (monochrome display adapter) standard, however, requires a VSF of 50 Hz. While a multiscanning monitor that operates at this frequency is capable of displaying MDA images, the effect is often less than pleasing because the lower-rate vertical frequency introduces flicker into the image. (In fixed-frequency MDA displays, long-persistence phosphors are used; these hide the flicker effect by retaining their glow between image frames.)

The rate at which the monitor must draw a line across its width increases as the on-screen resolution of the standard it is attempting to display increases. The lowest



MULTISCANNING MONITOR

The first multiple-frequency (multiscanning) monitor—MultiSync, from NEC Home Electronics (USA)—was capable of working with both TTL and analog adapters, including CGA, EGA, and PGC. Introduced at Fall Comdex '85, the MultiSync won *PC Magazine*'s Technical Excellence award for graphics hardware in 1986. At the time, Bill Machrone called it "the ideal hedge against emerging technologies."

VGA

The Video Graphics Array adapter, introduced with IBM's PS/2 line, offers a palette of 262,144 colors. VGA provides 256 colors at 320 by 200 resolution, or 16 at full 640 by 480 resolution. It requires an analog rather than TTL signal. Though VGA was originally available only for Micro Channel machines, within a year board manufacturers successfully created cards to port the higher resolution to standard PC buses.

SUPER VGA

Promoted by a consortium of monitor and graphics board manufacturers called VESA, Super VGA (also called extended VGA or VGA Plus) offers 800 by 600 graphics resolution, with 56 percent more on-screen pixels than VGA. It uses 16 colors out of a palette of 256, which may not prove enough for serious graphics users, but should prove sufficient for *Microsoft Windows* and text-mode users. Adapters capable of displaying 256 colors are readily available but are not addressed by VESA. Super VGA adapters cost little more than regular VGA adapters.

NONINTERLACED 1,024 BY 768

Compaq is now promoting noninterlaced 1,024 by 768 resolution, targeted toward high-end graphics users such as CAD/CAM aficionados. Its boards offer 256 colors with a 512K memory addition. Meanwhile, in the same market, IBM is promoting interlaced 1,024 by 768 resolution with its 8514/A adapter, introduced in 1987 with the PS/2 line. The board comes with 500K of memory, allowing 16 colors to be simultaneously displayed. The interlaced display, however, is more likely to produce flicker. At present, not much software exists to support either adapter, and compatible monitors are costly.

horizontal scanning frequency that one of these multiscanning monitors might face is the 15.575 kHz used by IBM's CGA standard. The EGA standard uses a horizontal frequency of 22.1 kHz.

To accommodate the VGA standard, monitors must handle a horizontal frequency of 31.5 kHz and two distinct vertical frequencies, 60 Hz and 70 Hz. Going up to Super VGA's 800 by 600 pixels requires the monitors to deal with slightly more than 35 kHz of horizontal frequency and a vertical frequency of 60 Hz.

Since most of the multiscanning monitors reviewed here have maximum horizontal frequencies of only 35 kHz, it would seem that displaying Super VGA images is just out of their range—especially since many of them are rated at 800 by 560 pixels rather than 800 by 600. Nevertheless, all of the units reviewed in this issue were able to display the 800- by 600-pixel images produced by the Video Seven V-RAM VGA board that was used for evaluation.

That these monitors can produce images at resolution levels beyond their rated limits is hardly a miracle. The frequency-handling limits determined by a monitor's manufacturer are posted to ensure safe operation (for example, to keep the operating temperatures of inductive components such as flyback transformers and semiconductors within acceptable limits) and long machine life; most monitors can exceed these limits. But, higher scanning frequencies stress critical circuits more than lower frequencies, causing the circuits to produce greater amounts of heat.

According to a spokesperson from Magnavox—which recently discontinued its sole multiscanning monitor—the added heat generated by operating a monitor at frequency levels above its posted design limits may make it less reliable and hasten its demise. The makers of the multiscanning monitors with rated specifications below those called for by Super VGA disagree. These manufacturers contend that displaying 800- by 600-pixel images will have no ill effects on their monitors.

TAKING CONTROL Perhaps the greatest difference you'll find between multiscanning and analog monitors is their degree of image control.

The point of greatest similarity between monitors is in the locations of their brightness and contrast controls, the most frequently used image controls. Most manufacturers put these vital controls, which play the same role as their TV counterparts, on the monitor's face, making them easily accessible (14 of the 19 monitors had front-mounted brightness and contrast controls; in 12 cases these were thumbwheels). The location and operation of most of the other controls on multiscanning monitors vary markedly, however.

These monitors don't come cheap, but take heart—$1,000 monitors can sell for half that on the street.

If your monitor does not come with autosizing capabilities (see the sidebar "Sizable Problems"), or if the autosizing doesn't work properly, the horizontal and vertical size controls are especially important. These controls allow you to adjust not only the image's width and height, but also its aspect ratio. If this ratio (determined by eyeball measurements) of vertical to horizontal pixels is off (it should always equal 1.33), the shape of graphics displayed onscreen is distorted. The size controls for most of these multiscanning monitors are located on the monitors' backs, which can make them rather difficult to use.

For their own reasons, many makers restrict the amount of vertical and horizontal size control their monitors provide. If the range is too restricted, you may be unable to fill your screen with image at some resolutions. Several displays don't offer fully adjustable horizontal size, giving you either no control (Taxan) or a two- or four-position switch (AOC International, CTX International, Samsung, Tatung, and TW Casper) instead. Although setting image width usually is not as critical as setting height, the greater flexibility offered by a true horizontal size control is generally preferable.

Each different-resolution graphics standard that you ask a multiscanning monitor to display is likely to place the image in a different spot at first. Horizontal and vertical position controls allow you to move the image around. These controls help you ensure that no part of the image is cut off and that the black dead space around the image is equal on all four sides of the tube. Ideally, these controls should allow you to move the image beyond the edge of the screen on all four sides. Like the size controls, most of these monitors' positioning controls are on their backs, making them difficult to use.

THE PRICE YOU'LL PAY The 19 monitors reviewed in this issue include models from AOC International, CTX International, Electrohome, Goldstar, Leading Technology, Microvitec, Mitsubishi, Nanao, NEC, Princeton Graphic Systems, Relisys, Samsung, Sony, Tatung, Taxan, 3Lynx, and TW Casper. (Many manufacturers, including industry giants IBM and Compaq, make only fixed-frequency monitors, cost and ease of use being among the reasons cited.)

As a rule, multiscanning monitors don't come cheap, especially compared with fixed-frequency displays: the ones reviewed here ranged from $595 to $1,399. In comparison, IBM's fixed-frequency VGA 8513 lists at $750; Compaq's VGA Video Graphics Color Monitor is $699. But take heart—multiscanning monitors display large disparities between list and street prices. Some monitors tagged in the $1,000 range are readily available for little more than half that figure. And having the ability to display Super VGA makes sense (see the sidebar "VESA: Looking Forward to a New Standard").

To put our monitors through their paces, we teamed each with an 8-MHz IBM PC AT fitted with a Video Seven V-RAM VGA board capable of generating the signals profiling the 640 by 200 CGA through noninterlaced 1,024 by 768 resolution. We used a series of PC Labs monitor tests to aid us in judging the clarity, resolution, linear distortion, color purity, and misconvergence of each monitor. We generated signals profiling the CGA through 1,024 by 768 resolution using *Microsoft Windows*, and the boards supplied had drivers for resolutions beyond standard VGA. Though we tried to rate them as objectively as possible, the nature of monitors makes reviewing them somewhat subjective. For this reason, we suggest using our reviews only as guidelines: you're best off to narrow your choices to the few that seem best, then try them yourself with your most important applications.

AOC INTERNATIONAL (USA) LTD.

CM-314

It has all the right stuff, but the $799.95 CM-314 color video monitor by AOC International (USA) proves a notch below the rest because its engineers failed to pay proper attention to detail. During testing, the cover of its side-mounted control panel fell off. The Taiwan-made monitor also showed the worst convergence of all the displays tested.

Featuring a .31mm dot pitch, shadow mask tube with an almost-black matrix and antiglare treatment, the CM-314 has all the components required to produce an average image. And it does perform well in some respects: it shows no geometric distortion, and its image size increases only

PC MAGAZINE FACT FILE

AOC International CM-314
AOC International (USA) Ltd.
10991 NW Airworld Dr.
Kansas City, MO 64153
(816) 891-8066
(800) 443-7516
List Price: With DB-9 connector cable and DB-15 adapter, $799.95.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: This 14-inch, Taiwan-made display would be a good generic pick if its makers paid more attention to quality control

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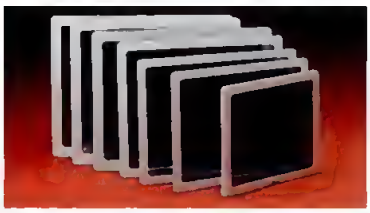
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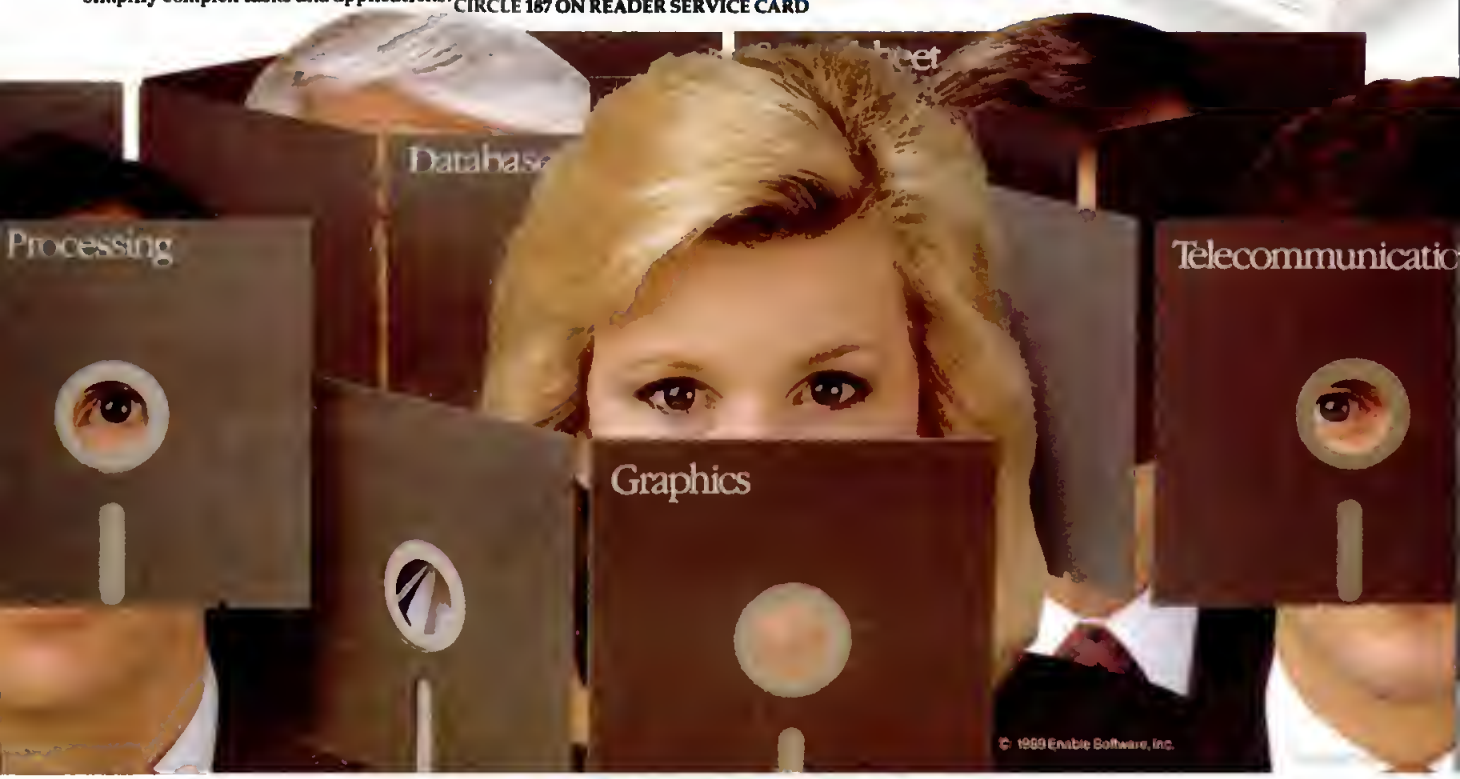
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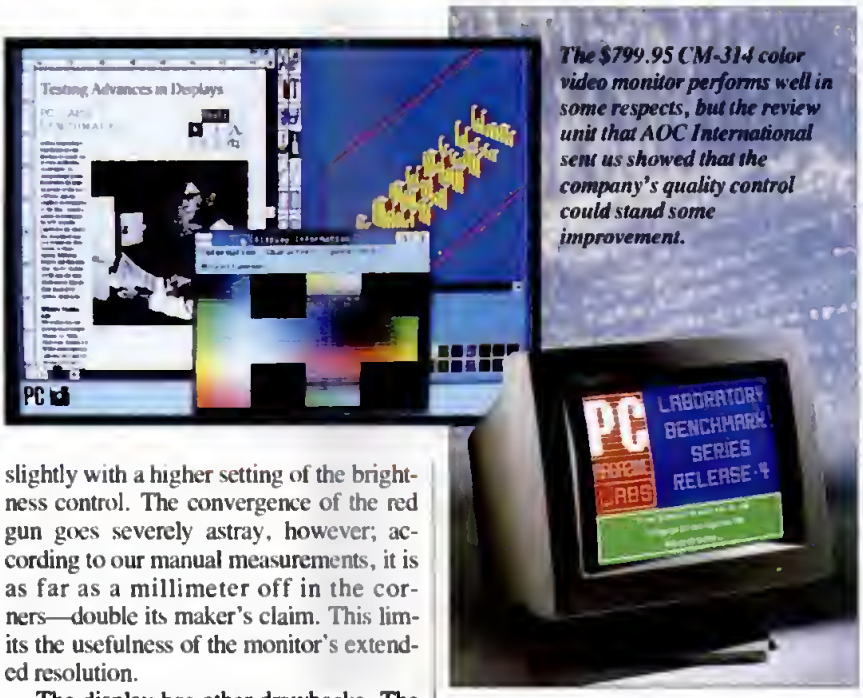
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The $799.95 CM-314 color video monitor performs well in some respects, but the review unit that AOC International sent us showed that the company's quality control could stand some improvement.

slightly with a higher setting of the brightness control. The convergence of the red gun goes severely astray, however; according to our manual measurements, it is as far as a millimeter off in the corners—double its maker's claim. This limits the usefulness of the monitor's extended resolution.

The display has other drawbacks. The image consistently folds over ½ inch inside the left bezel edge and ⅜ inch inside the right, a problem the shaft-shaped horizontal-positioning knob does little to alleviate. In VGA text mode, only one image size—9¾ by 7⅜ inches (12¼ inches diagonally)—achieves the proper 1.33-pixel aspect ratio, due to the limited picture-width control afforded by the horizontal-size-control slide switch. This switch is almost useless in VGA modes, and the monitor is unable to maintain its optimal text-mode size in the other VGA modes. Images made in the 350-line mode measure a full inch shorter. The monitor has no autosizing capabilities.

The shaft-like vertical-size control can be used to blow the image up to nearly double the screen height. Both image size controllers, as well as shafts for controlling horizontal and vertical positioning and vertical hold, are located behind a precariously positioned door in the side-mounted control panel. Also located there are the contrast and brightness controls; the CM-314 is one of the few monitors not to have these important controls located on its face. Two LEDs that indicate text-mode and TTL (digital input) operation are hidden in this control panel, as well—a location that is, of course, ludicrous.

The CM-314 is average in size: 14½ by 14¼ by 14½ inches (HWD), including its built-in tilt/swivel stand. It looks somewhat bulky, however, because its white-beige case tapers only a little toward the rear panel. The screen bezel is the same color as the rest of the case and masks the 14-inch display tube down to a visible diagonal measuring 13¼ inches. Power is controlled by a rocker switch under the front bezel.

According to AOC International, the monitor can accommodate all IBM display standards, both digital and analog, except 8514/A. The CM-314 bears an FCC Class B certification. With the monitor, AOC supplies a 53-inch cable terminating in 9-pin D-shells at either end. A 9- to 15-pin adapter is also included for use with VGA systems.

With more attention to quality control, the CM-314 would be a good choice for a generic multiscanning monitor. If you're considering one, check the set you plan to buy before paying for it.

—Winn L. Rosch

CTX INTERNATIONAL INC.

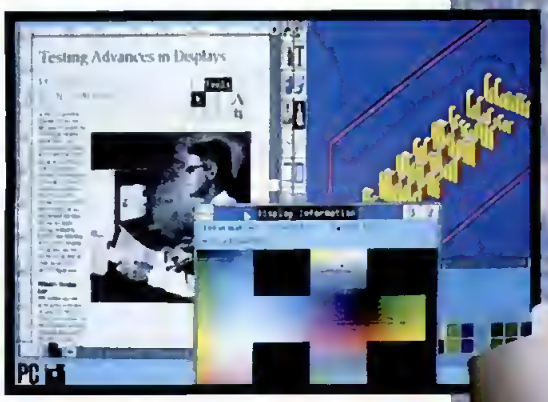
CTX 3435

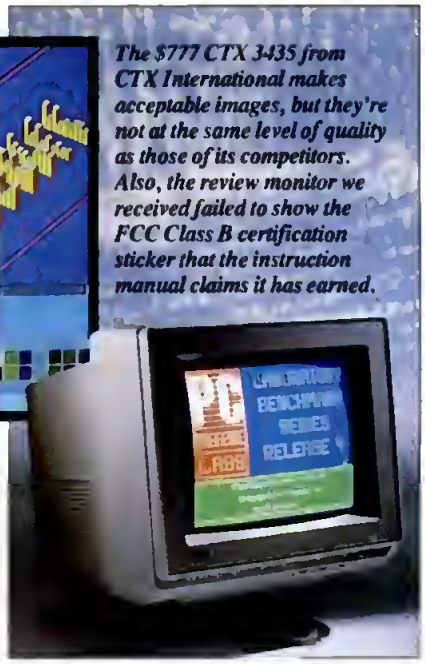
Taiwan has long been trying to improve the reputation of its high-tech products in the hopes of competing more successfully with its Pacific Basin neighbor, Japan. The CTX 3435 multiscanning monitor, unfortunately, will contribute nothing toward achieving that goal. Not that the $777 monitor from CTX International won't make acceptable images—they're just not the same quality as those produced by the other displays we reviewed.

Made by Chuntex Electronics, the CTX 3435 looks ordinary enough; a squat and blocky beige-white box on a built-in tilt/swivel stand, measuring 14½ by 14 by 15¾ inches. A darker, gray-beige bezel masks off the 14-inch display tube to a 10¾- by 7¾-inch viewing area (13 inches diagonally). However, the first questions about this monitor arise when you look for its certification: although the instruction manual indicates that the CTX 3435 has received FCC Class B certification, the plastic case of the evaluation display bears no approval sticker. Moreover, it is extremely susceptible to interference generated by nearby electrical equipment, which produces pronounced "hum bars" in its image.

If its engineers paid more attention to quality control, the CM-314 would be a good generic monitor.

The CTX 3435's other principal shortcoming is its lack of autosizing abilities. Though a slide switch on its rear panel marked "Auto/Manual" supposedly switches full IBM-compatibility on and off, the CTX 3435 does not even fully compensate for all IBM standards. In VGA mode, image height ranges from 6¾ inches in 400-line mode to 7¾ inches for 480-line graphics mode. Switching to 600-line images makes the image taller than the screen and distorts its aspect ratio.





The $777 CTX 3435 from CTX International makes acceptable images, but they're not at the same level of quality as those of its competitors. Also, the review monitor we received failed to show the FCC Class B certification sticker that the instruction manual claims it has earned.

No matter what the mode, the image cannot be made to fill the screen; it folds over ½ inch before the left bezel edge and is cut off ⅜ inch inside the right edge. The largest image with proper aspect ratio that can be achieved measures 9¼ by 7¾ inches (12 inches diagonally).

Not that every aspect of the monitor's image making is poor: the CTX 3435 actually appears to have better convergence than its .6mm claim. According to our manual measurements, convergence never varied more than about .4mm in the evaluation unit, close to the .31mm dot pitch of the direct-etch antiglare-treated tube. The image geometry and colors are good, with the exception of IBM brown, which has a distinctly orange tint. As image brightness is increased, text blooming is minimal, although the image does increase slightly in size with brightness.

Like most of these multiscanning monitors, the CTX 3435's brightness and contrast controls are thumbwheels located under the screen bezel. Unfortunately, the icons labeling these controls on the review unit were reversed. Most of the remaining monitor controls are located on the rear panel, including the control to adjust horizontal image size. Operated by a slide switch, this control has no effect on signals with horizontal frequencies from 15 to 20 kHz and little effect with others.

Compatibilities claimed for the CTX 3435 include only CGA, EGA, and PGC, although the instructions also indicate that connections are possible with PS/2 computers. In practice, the CTX 3435 exceeds its claims, as it works well with the VGA circuitry of a PS/2 and handles the 800- by 600-pixel mode of the Video Seven V-RAM VGA board without a problem. The latter accomplishment is impressive, given the 800- by 560-pixel and 30-MHz bandwidth specifications of the monitor. CTX International supplies a 9-pin cable and a removable 69-inch cable terminating in a 15-pin, high-density, D-shell connector for making the VGA connection.

The CTX 3435 is viewable but not commendable. Its lack of an FCC sticker, generally poor performance, and outdated manual make it impossible to recommend. Only the CTX's very low street price should tempt you into buying it.

—Winn L. Rosch

PC MAGAZINE FACT FILE

CTX 3435
CTX International Inc.
161 Commerce Way
Walnut, CA 91789
(714) 595-6146
List Price: With DB-9 connector cable and DB-15 adapter, $777.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: The images produced by this Taiwan-made, 14-inch display are of lower quality than those of its peers, and its FCC Class B certification is questionable.

CIRCLE 398 ON READER SERVICE CARD

ELECTROHOME LTD.
ECM 1310U
ECM 1311U
ECM 1312U

Unlike any of its competitors, Electrohome Electronics Ltd. takes a mix-and-match approach to display-screen characteristics. Though the three monitors it offers are expensive ($1,198 each), they're all generally good.

Each of Electrohome's multiscanning monitors offers a different combination of phosphor and screen glass. In any flavor, the cables and tilt/swivel base add to the monitor's already hefty price.

The ECM 1310U is equipped with a conventional short-persistence phosphor screen topped by the usual low-glare, etched-screen glass. The ECM 1312U offers long-persistence phosphor and a polished screen, making it just the ticket for CAD/CAM and interlaced-display-adapter aficionados seeking the last word in clarity (at the expense of high background glare). Finally, the ECM 1311U combines the long-persistence display with an etched

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Electrohome ECM 1310U
Electrohome ECM 1311U
Electrohome ECM 1312U
Electrohome Ltd.
809 Wellington St. North
Kitchener, Ontario
Canada N2G 4J6
(519) 744-7111
List Price: $1,198 each, no cables included. Tilt/swivel base, $49; VGA cable (DB-15 connector), $99; DB-9 connector cable, $59; PGC connector cable, $79.
Requires: Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter. 1311U and 1312U accept 8514/A adapter and interlaced signal.
In Short: Three peas in a pod, with differences only in phosphor persistence and screen etching to tell them apart. The ECM 1310U, with its etched screen and short-persistence phosphor, is the best choice for most applications. These monitors are suitable for most tasks, and the inclusion of video outputs makes them the units of choice where multiple displays are required.

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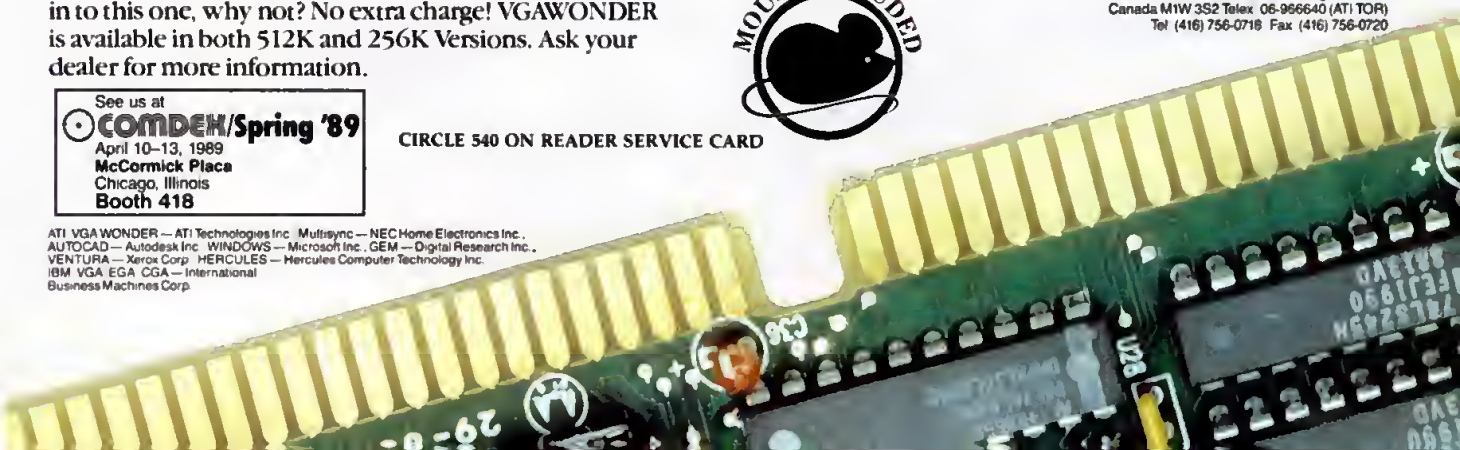
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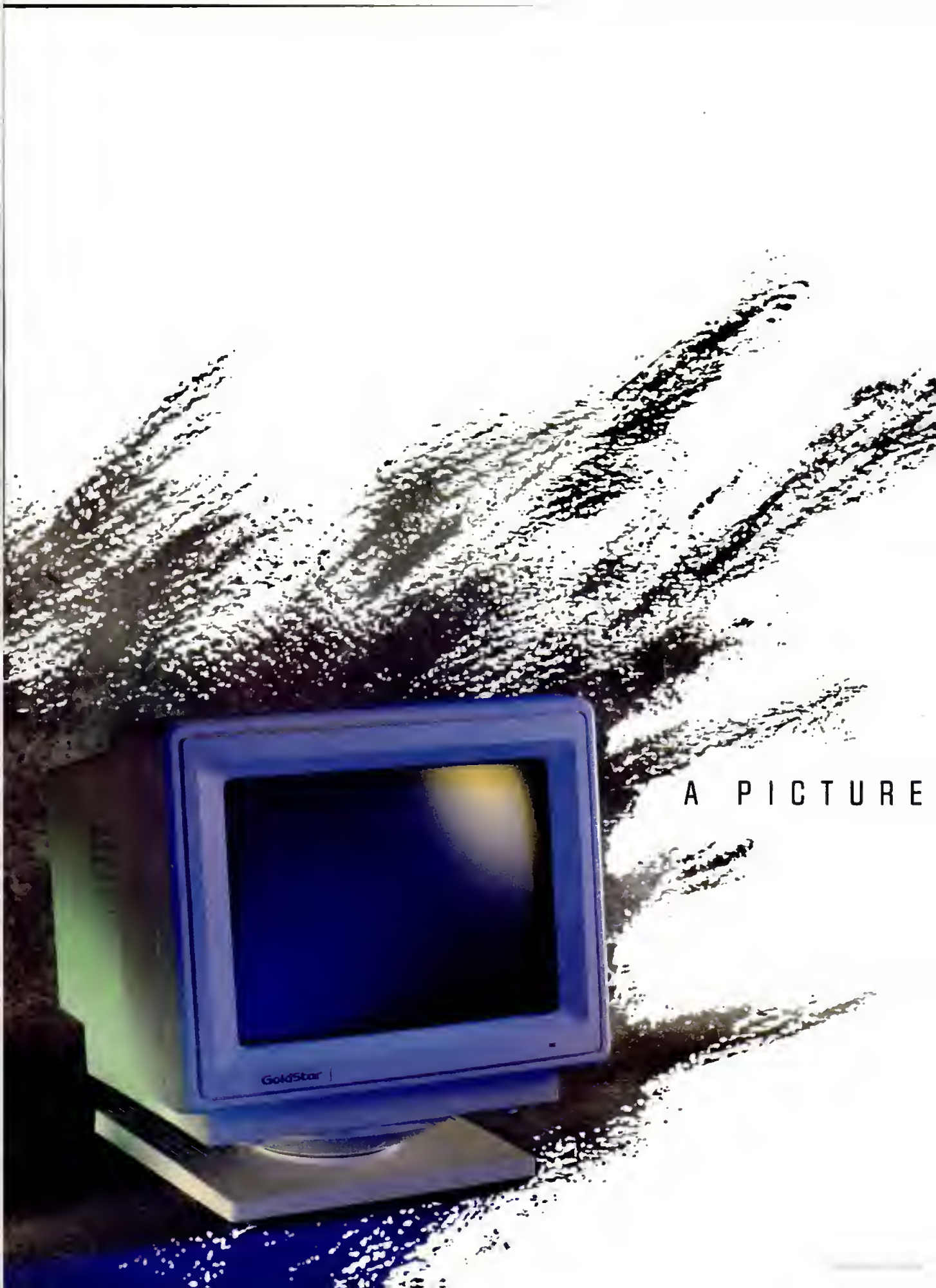
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CIRCLE 540 ON READER SERVICE CARD

ATI VGA WONDER — ATI Technologies Inc. Multisync — NEC Home Electronics Inc.,
AUTOCAD — Autodesk Inc. WINDOWS — Microsoft Inc., GEM — Digital Research Inc.,
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IBM VGA EGA CGA — International
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A PICTURE
GoldStar

GoldStar

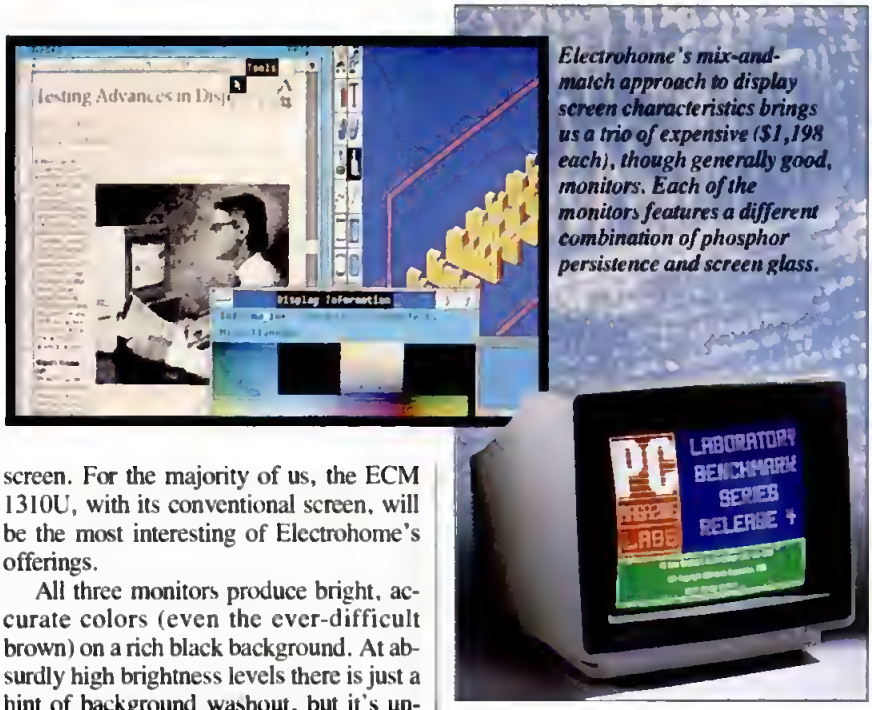


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CIRCLE 199 ON READER SERVICE CARD



Electrohome's mix-and-match approach to display screen characteristics brings us a trio of expensive ($1,198 each), though generally good, monitors. Each of the monitors features a different combination of phosphor persistence and screen glass.

screen. For the majority of us, the ECM 1310U, with its conventional screen, will be the most interesting of Electrohome's offerings.

All three monitors produce bright, accurate colors (even the ever-difficult brown) on a rich black background. At absurdly high brightness levels there is just a hint of background washout, but it's unlikely that one would ever need such intensity levels.

The two long-persistence models exhibit one color all their own that can be a bit unnerving: a dark-green afterglow that persisted long after an illuminated area

Electrohome monitors offer different combinations of phosphor and screen glass.

was supposed to return to black. While not a problem with static images, it results in a disquieting lack of sharpness with moving images (whether scrolling text or moving graphics).

One shortcoming common to all three Electrohome monitors is their failure to ensure adequate horizontal-image size control. The rear-mounted potentiometer allows for a scant ¼-inch variation in image size, and the sizes range from slightly too large to larger still. At its smallest setting, approximately ⅛ inch of either the right or left edge is cropped off in the corners. The machines do have underscan switches, but their use reduces the image size excessively, resulting in a blank area of approximately 1 inch around the entire display screen.

Video versatility is certainly one of the strong points for these monitors, each of which is equipped with no less than 11 signal connectors. These monitors also include separate-sync signal lines for each primary color gun and the timing signals. These latter connectors can be linked to a VGA adapter by an optional ($99) cable that looks like a long, slender squid: it consists of a standard 15-pin VGA connector terminating in five 60-inch signal cables. The DB-9 connector (for CGA, MDA, EGA, and Hercules board installations) is $59.

Electrohome is the only video display vendor to include separate-sync video output connectors with its monitors. Given enough BNC-connector-equipped cables (and by opening the terminator switches on all but one monitor), you can daisy-chain multiple displays together. This capability could make for an interesting—albeit potentially expensive—alternative to the monster monitors used in training-group sessions.

Despite their shortcomings, the Electrohome monitors remain a viable choice, but let's face it: if ever there was a name that begged to be changed, it's Electrohome. It sounds like a moniker suitable for a purveyor of inexpensive fold-out speaker-and-turntable stereo systems for the family Winnebago. The maker of this trio of sparkling monitors should have a name that connotes something better.

—Frank Bican

GOLDSTAR ELECTRONICS INTERNATIONAL INC.

Goldstar 1440 Super

At first glance, the Goldstar 1440 Super color monitor from Goldstar Electronics International reminds one of a cube-like Sony Trinitron television. The screen of the $799 monitor fills most of the front panel, giving it a trim look very similar to that of Taxan's MultiVision 770 Plus. When it comes to performance, the favorable comparisons end. The Korean monitor, unfortunately, distinguishes itself from the rest of the lineup by poor performance.

The 1440 Super achieves excellent brown representation, brown being the most difficult color to produce. The hues of the rest of the colors are consistently flat, though. The Goldstar's electron guns are misaligned, particularly at the outer edges of the screen, where definite traces of red and blue are visible. This miscon-

PC MAGAZINE FACT FILE

Goldstar 1440 Super
Goldstar Electronics International Inc.
1130 E. Arques Ave.
Sunnyvale, CA 94086
(408) 737-8575
List Price: With DB-9 connector cable and DB-15 adapter, $799.
Requires: MDA, CGA, EGA, or VGA video card.
In Short: At $799, this is a midrange-priced monitor that does little to distinguish itself positively. You can do better for the money.

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VESA: LOOKING FORWARD TO A NEW STANDARD

Necessity may be the mother of invention, but sometimes programmability is the mother of necessity. Back when NEC Home Electronics introduced the MultiSync monitor, it was a good idea—definitely a nice piece of equipment to have. Was it necessary? No. It did, however, address a need. When EGA was introduced, it was clearly a turbulent time for video standards. The MultiSync promised shelter from obsolescence as a storm of suggested standards raged among the board, software, and computer manufacturers. It even offered analog input. We all wondered what anyone would ever do with that.

Now, with the advent of VGA, the advantages of analog are abundantly clear. And the hardware is still programmable. Resolutions of up to 800 by 600 pixels are a piece of cake for today's VGA boards, and multiscanning monitors are the right way to view the resulting crisp graphics.

Trouble is, each board manufacturer and software vendor has its own idea of how best to achieve 800 by 600: what horizontal timing to use, what vertical refresh rate, what mode number. The monitors, of course, can deal with the differences, but at the price of constantly readjusting the size and position controls.

NO AXE Enter, once again, NEC. Along with eight of the leading video-board manufacturers, the company has founded the Video Electronics Standards Association. VESA's goal is to standardize the electrical, timing, and programming issues surrounding 800 by 600 resolution, commonly known as Super VGA. The committee is probably the first standards group in the history of this industry that doesn't have a commercial axe to grind. Sure, NEC wants to sell more monitors, and the board manufacturers want to sell more boards. But the standard, as it is being drafted, hurts no one—not even competing monitor manufacturers.

New standards usually sacrifice some portion of the installed base on the altar of progress. To its credit, VESA has selected a fairly relaxed set of specifications that can be met by even the earliest monitors from NEC, Sony, Princeton Graphic Systems, and other manufacturers. The current crop of VGA monochrome monitors can do Super VGA, too; the combination of high resolution and 64 shades of gray is finding much favor in the desktop publishing crowd.

VESA's effort has all the earmarks of a perfect standard. Jerry Benson, NEC's marketing director for monitors, says, "Most standards committees are really espousing antistandards. We're not against anything. We simply want to give the consumer the maximum amount of resolution in an orderly fashion."

Notably absent from the group, however, is Compaq. Long accustomed to giving its customers "more IBM compatibility than IBM," Compaq is less motivated toward accepting Super VGA because IBM has been silent about it. Due to this reticence, Compaq may find itself outperformed and underpriced by manufacturers who buy their boards and their Super VGA compatibility from VESA members.

HOW GOOD? After all is said and done, is Super VGA all it's cracked up to be, or is it an all-but-imperceptible difference, such as Super VHS for VCRs? In my book, the difference between 640 by 480 and 800 by 600 is somewhere between obvious and breathtaking. With fully 50 percent more pixels on the screen, you get displays that are more readable and easier on the eyes. You can also fit more information on-screen because you're working with smaller characters and there are more of them both horizontally and vertically. Super VGA uses 16 colors out of a palette of 256, sufficient for *Windows* and text-mode users—virtually all business applications. A few new VGA boards are capable of 640 by 480 by 256 colors, far more suitable for graphic artists working with intricately shaded full-color images. Although VESA standards don't address this 256-color mode, the Super VGA–capable monitors handle it with ease, thanks to analog input.

—Bill Machrone

Bill Machrone is editor-in-chief and publisher of PC Magazine.

vergence results in a loss of true white and causes diminished brightness in the corners of the screen. Text is generally fuzzy, particularly within *Microsoft Windows*.

The monitor has difficulty displaying images in the outer edges of the screen. When vertical lines or the right and left vertical edges are not barreling out, they have a definite waviness, as if they'd been hand-drawn by a student in a high school art class. This trouble is most evident when

The Goldstar's resolution of 800 by 560 lines strains at running in Super VGA mode.

running *Windows* at 800 by 600 resolution, revealing the monitor's inability to appropriately control the image's sizing and position at that resolution. Too much information was being sent to the screen, leaving the monitor with no horizontal-image size control. Attempts to adjust the window cause either a very compressed, wavy image or one so large that it extends beyond the viewing area of the screen. The Goldstar specifications place the monitor's

a Stroke of Genius...



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Features	ProDesigner VGA Plus	ProDesigner VGA	Designer 800 VGA
Bus & BIOS Support	16 and 8 Bit	16 and 8 Bit	8 Bit
Extended VGA Modes			
360x480 256 colors	Yes	Yes	Yes
640x350 256 colors	Yes	With User Upgrade	With User Upgrade
640x480 256 colors	Yes	With User Upgrade	With User Upgrade
800x600 16 colors*	Yes	Yes	Yes
800x600 256 colors*	Yes	With User Upgrade	With User Upgrade
1024x768 16 colors*	Yes	With User Upgrade	No
3 - 132 column 16 color modes	Yes	Yes	Yes
100% Register and BIOS Compatible with VOA, MCGA, EGA, CGA, MDA and Hercules	Yes	Yes	Yes
Auto Mode Switch, Auto 8/16 Bus Sense and Auto Monitor Select	Yes	Yes	No
Suggested Retail Price	$599	$499	$399

** Supports these standards on both interlaced (IBM 8514 and compatibles) and non-interlaced (NEC Multisync XL and compatibles) monitors.*

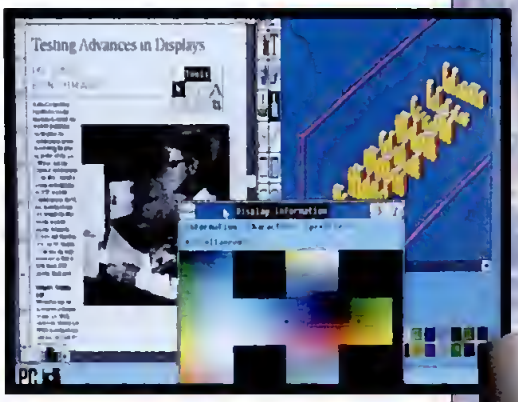
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CIRCLE 190 ON READER SERVICE CARD





This $799 monitor's trim look reminds one of a cube-like Sony Trinitron television, but, apart from its looks, Goldstar Electronics' 1440 Super distinguishes itself only by its poor performance.

resolution at 800 by 560 lines; it strains when running in Super VGA mode.

Both the vertical- and horizontal-image size controls and the position-adjustment controls work more effectively at the EGA and VGA levels. However, tinkering with any of the controls—save for the brightness and contrast controls located at hand's reach on the front panel—is difficult because most controls are at the rear of the case. If you're stout-hearted and believe that any amount of trouble is worth getting the perfect image, you'll want to fiddle with the 14 additional controls that Goldstar placed on the back of the monitor to help you get that custom fit. These controls

The $595 Imtec 1455N's strong points include its rich, accurate colors.

are deeply set into the case and require a Phillips screwdriver to adjust.

The 1440 Super comes with an unattached tilt/swivel base, yet the installation procedure could not be simpler, requiring only one screw. Without the base, the monitor stands 12 inches high, having a width and depth of 14 inches and 15 inches, respectively. Despite this condensed size, the 1440 Super still has a visible-screen size of 13¼ inches measured diagonally. The test unit came with only a DB-9 connector, so in order to test the Goldstar with the Video Seven V-RAM VGA card, a nine- to 15-pin adapter was necessary. Goldstar acknowledged to us that this was an oversight. The monitor normally ships with a 9- to 15-pin adapter. Cable length was a scant 43¼ inches.

Twice, I got zapped with a good shock of static charge while making sure that the Goldstar's connector was firmly attached to the video card (fiddling with the connector with my left hand while resting my right hand on the monitor screen). Too bad the rest of the Goldstar's performance was not so electrifying.—**Matt Ross**

LEADING TECHNOLOGY INC.
Imtec 1455N

Leading Technology's Imtec 1455N illustrates why the Koreans have recently been gaining so much ground in markets traditionally dominated by the Japanese. Like the bulk of the recent Korean high-tech offerings, the Imtec 1455N is of high quality, and, at $595, it's the least expensive of the 19 monitors we reviewed.

Leading Technology doesn't actually manufacture the Imtec 1455N, but purchases it from Imtec for resale in this country. Even with this added level in the profit-taking chain, the 1455N lists at less than half as much as the like-sized NEC MultiSync Plus. It can't match the NEC's outstanding performance, but that seems excusable considering the 1455N's price.

Among the monitor's visual strong points are its rich, accurate colors—even the ever-difficult brown. Character sharpness is also quite good, with only the slightest bit of softening in the corners. The screen has a fairly high degree of etching, which should make for low background glare under most circumstances, though the monitor didn't score particularly well on our glare tests.

Before you rush to the phone with credit card in hand, however, be aware that the cost-cutting measures required to bring you this monitor at such a low price have resulted in a few problems and omissions. At very high brightness levels, the background exhibits some washout, with black fading to dark gray. Additionally, as the brightness is increased, the image size blooms just a bit. There is also a small amount of pincushion distortion along the vertical edges of the screen, and no amount of adjustment seems to eliminate it.

Conspicuously lacking in the 1455N's repertoire is automatic vertical-image sizing. As a result, changing among graphics standards requires you to make readjustments using the vertical-size control knob, which is inconveniently located, along with many other controls, on the back of the cabinet.

More disappointing still is the moni-

FACT FILE

Imtec 1455N
Leading Technology Inc.
10430 SW 5th Ave.
Beaverton, OR 97005
(503) 646-3424
(800) 999-5323 (outside Oregon)
List Price: With DB-9 connector cable, $595. DB-15 and Mac II connector cables, $24.95 each.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: Favored with decent colors and image quality, this monitor's list price of just $595 makes it rate as something of a steal.

CIRCLE 401 ON READER SERVICE CARD

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Sony Computer Peripherals

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CIRCLE 745 ON READER SERVICE CARD

Multiscanning Monitors: Summary of Features

(Products listed in ascending price order)

	Imtec 1455N Leading Technology Inc.	Casper TM-5155H TW Casper Corp.	IntelliSync SCC-1435 3Lynx Technologies Corp	Samsung Sync Master CN4551 Samsung Electronics America Inc.	CTX 3435 CTX Int'l. Inc.	Relisys RE5155 Relisys	Goldstar 1440 Super Goldstar Electronics Int'l. Inc.
PHYSICAL SPECIFICATIONS	$595.00	$658.00	$695.00	$699.00	$777.00	$795.00	$799.00
Includes tilt/swivel	●	●	●	●	●	●	●
Includes cables	●	●	●	●	●	●	●
Visible screen size (diagonal, in inches)	13 1/3	13	12 7/8	13 3/8	13	13 3/8	13 1/4
Case dimensions (inches)							
Height	15	14	13 3/8	14 3/4	14 1/2	14	12
Width	14 3/16	14 1/4	13 1/2	14 1/4	14	14 1/2	14
Depth	14 3/4	15	15	14 3/4	15 3/4	14 7/8	15
Length of monitor cable (inches)	48	43	39	48	69	53	43
Cable removable at monitor end	○	●	●	●	●	●	●
OPERATIONAL FEATURES							
Maximum resolution (pixels)							
Width	800	800	940	800	800	800	800
Height	560	560	600	560	560	560	560
Video bandwidth (MHz)	30	30	30	30	30	40	30
Vertical scanning frequency range (Hz)	58–72	47–70	45–120	58–72	50–70	45–80	45–85
Horizontal scanning frequency range (kHz)	15.5–35	15–35	15.7–35	15.5–35	15.5–35	15.5–35	15–35
Dot pitch (mm)	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Autosizing	○	○	○	● (IBM only)	○	● (IBM only)	○
Inputs (separate socket or switch-selectable)							
Analog/TTL RGB	● (Switch)	● (Switch)	● (Switch)	● (Switch)	● (Switch)	● (Switch)	● (Socket)
Composite	○	○	○	○	○	○	○
Separate sync	○	○	○	○	○	○	○
Outputs (separate socket or switch-selectable)							
Analog/TTL RGB	○	○	○	○	○	○	● (Switch)
Composite	○	○	○	○	○	○	○
Separate sync	○	○	○	○	○	○	○
CONTROLS							
Brightness	●	●	●	●	●	●	●
Contrast	●	●	●	●	●	●	●
Color	○	○	○	○	○	○	○
Horizontal position	●	●	●	●	●	●	●
Vertical position	●	●	●	●	●	●	●
Horizontal size	○	●	●	●	●	○	●
Vertical size	●	●	●	●	●	●	●
Overscan (enlarges image)	○	○	○	○	○	○	○
Underscan (reduces image)	●	○	○	○	○	○	○
Vertical hold	●	○	○	○	●	○	○
Monochrome text switch	●	●	○	○	●	●	●
Color selector for text	●	○	●	●	○	●	○
120/240-volt switch	○	○	○	○	○	○	○
8/16/64-color switch	○	●	●	●	○	●	●
Other	None	None	Manual/off, mono/color/ inverse	Manual/presel	Auto/manual, monochrome/ color	Auto/manual scan mode	None
GRAPHICS STANDARDS COMPATIBILITY							
MDA	●	●	●	○	●	●	●
Hercules	●	●	●	○	●	●	●
CGA	●	●	●	●	●	●	●
EGA	●	●	●	●	●	●	●
PGC	●	●	●	●	●	●	●
VGA	●	●	●	●	●	●	●
8514	○	○	○	○	○	●	○

–Editor's Choice ● –Yes ○ –No

AOC Int'l. CM-314 AOC Int'l. (USA) Ltd.	Princeton Ultrasync Princeton Graphic Systems Inc.	Diamond Scan 14 Mitsubishi Electronics America Inc.	Taxan Multi/Vision 770 Plus Taxan USA Corp.	Nanao 8060S Nanao USA Corp.	Sony CPD-1302 Sony Corp. of America Inc.	Electrohome ECM 1310U, 1311U, and 1312U Electrohome Ltd.	Microvitec 1014/SP Auto-Sync Microvitec Inc.	Tatung 1595G Tatung Co. of America, Inc.	NEC MultiSync Plus NEC Home Electronics (USA) Inc.
$799.95	$849.00	$889.00	$915.00	$939.00	$995.00	$1,198.00	$1,199.00	$1,199.00	$1,399.00
●	●	Optional	Optional	● (Tilt only)	Optional	Optional	●	●	●
●	●	●	●	●	Optional	Optional	Optional	●	●
13 1/4	11 1/2	13	13	13	13 1/8	13	13 1/4	13 1/2	13 1/2
14 1/2	12 1/2	12 3/4	12	15 3/4	12	13	13 1/8	14 1/2	15 1/3
14 1/4	12 1/3	14 1/4	14	14	14	14	16	14 1/3	14
14 1/2	14 3/16	14 3/4	15	15	15	15	15	15 1/2	16
53	73	48	51	76 (VGA), 63 (EGA)	50	60	74	71	65
●	●	●	●	●	●	●	●	●	●
600	600	600	600	820	900	910	930	600	960
600	600	600	600	620	560	675	604	600	720
30	30	30	30	30	30	30	40	30	55
50–80	45–120	45–90	50–90	50–80	50–100	47–85	45–100	40–120	56–80
15–35	15–35	15.6–36	15–34	15.75–35	15–34	15–34	15–37	15–37	21.8–45
0.31	0.28	0.31	0.31	0.28	0.26	0.31	0.31	0.31	0.33
○	● (IBM only)	● (IBM only)	●	○	● (IBM only)	● (IBM only)	○	○	●
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●	●	●	●	●	●	●	●	●	●
●	●	●	○	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●
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○	○	○	○	○	○	○	●	○	○
●	●	●	○	●	○	○	○	●	●
None	None	Analog/TTL/ video	None	None	TTL mode	None	None	PS/2/color/ mono	BNC input voltage, manual scan mode
●	●	●	●	●	●	○	●	●	●
●	●	●	●	●	●	●	●	●	●
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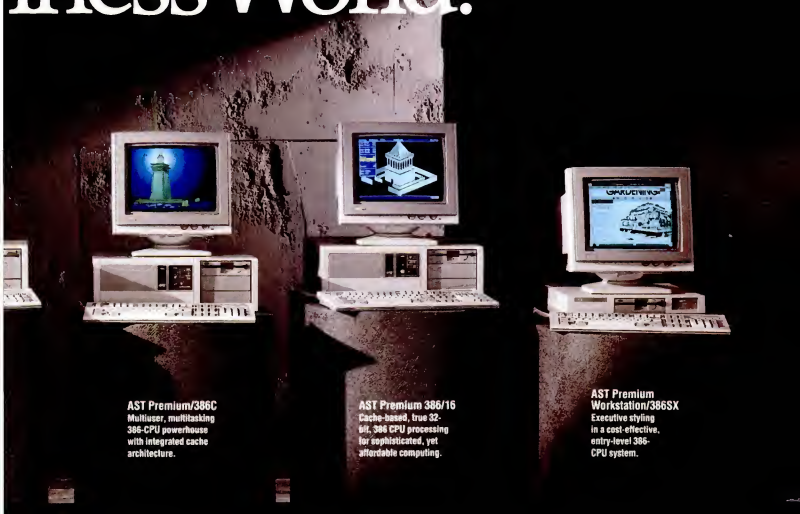
Times Have Changed.

CIRCLE 166 ON READER SERVICE CARD

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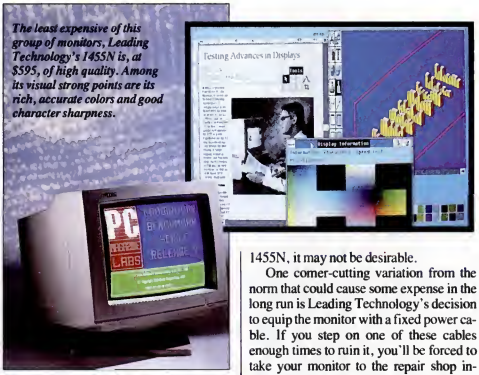
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The least expensive of this group of monitors, Leading Technology's 1455N is, at $595, of high quality. Among its visual strong points are its rich, accurate colors and good character sharpness.

tor's lack of a potentiometer-type horizontal-size control. A two-position switch is supplied instead, but its selections are limited to too small and smaller still. At its larger setting, and in standard 640- by 480-pixel VGA display mode, the image measures just 9¼ inches horizontally, with ¾ inch of unused screen along both the left and right edges. Changing to an 800- by 600- pixel *Windows* display further reduces the image area, decreasing the horizontal axis to just 8½ inches. So while it may be possible to achieve 800 by 600 resolution with Leading Technology's Imtec 1455N, it may not be desirable.

Running *Windows* in Super VGA reduces the Imtec 1455N's screen image to just 8½ inches horizontally.

One corner-cutting variation from the norm that could cause some expense in the long run is Leading Technology's decision to equip the monitor with a fixed power cable. If you step on one of these cables enough times to ruin it, you'll be forced to take your monitor to the repair shop instead of just buying a new cable and plugging it into a jack.

Leading Technology's Imtec 1455N has its shortcomings, but it's just too hard to overlook the monitor's price in relationship to its acceptable (if not universally compatible) performance.—**Frank Bican**

MICROVITEC INC.

Microvitek 1014/SP Auto-Sync

We've grown so accustomed to seeing computers and peripherals being manufactured in the Far East that the point of origin of Microvitec's 1014/SP Auto-Sync comes as something of a surprise: England. Aston-Martins, yes; Watney's Red Barrel Beer, yes; but a multiscanning monitor? Indeed, and quite an appealing one at that.

What immediately sets this $1,199 monitor apart is its shape. Instead of exemplifying the cubic form into which most monitors have evolved, the 1014/SP's shape is decidedly rectangular, wider than it is tall. It looks more like a television set than do most monitors, but, quite frankly, the effect is a pleasant change.

Unusual, too, is the power switch on the 1014/SP. Though convention dictates—on switches ranging from the ones controlling room lights to those that turn PCs on and off—that "up" should be equated with "on," the 1014/SP's switch works just the opposite. Pushing down the monitor's power switch reveals a green power-on indicator dot located on the top part of the switch. You probably have to expect such logic reversals in products manufactured by a nation that allows its motorists to drive on the wrong side of the road; nonetheless, Microvitec could save us confusion by changing to an illuminated switch.

The 1014/SP does automatic image sizing, but only of the "IBM VGA only" variety. It can handle all of the VGA display adapter's modes with no problem, but when it is fed an 800- by 600-pixel *Windows* display from a Video Seven V-RAM VGA dislay adapter, the sizing circuitry goes galley-west. As a result, the image size is reduced approximately 1 inch horizontally and displaced against the right-hand edge of the screen.

Problems with the 800 by 600 displays are exacerbated by the monitor's manual image controls. Located on the back of the cabinet, the controls can't fully compensate for the loss of size and position. (The brightness and contrast controls are more conveniently located behind a hinged plastic door on the right-front of the monitor's cabinet.)

In less demanding video modes, however, the 1014/SP's image quality is quite good. No linear distortion can be detected at any point on the screen, and character sharpness remains quite high right to the

FACT FILE

Microvitek 1014/SP Auto-Sync
Microvitec Inc.
1943 Providence Ct.
College Park, GA 30337
(404) 991-2246
List Price: With DB-9 connector cable, $1,199. DB-15 connector cable, $34.95.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: Its English heritage and distinctive cabinet styling, along with a reasonably high-quality image, make this monitor a fine choice in this crowded field.

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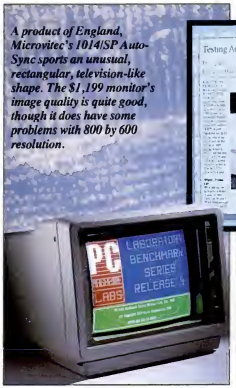
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CIRCLE 264 ON READER SERVICE CARD



A product of England, Microvitec's 1014/SP Auto-Sync sports an unusual, rectangular, television-like shape. The $1,199 monitor's image quality is quite good, though it does have some problems with 800 by 600 resolution.

corners. A small amount of image bloom can be seen as image brightness increases, but it isn't enough to be much of a bother. Color saturation is excellent, and images do not wash out, even at exceptionally high brightness levels.

Aston-Martins, yes; but a multiscanning monitor from England? Indeed, and it's quite appealing.

One standard feature of the 1014/SP worth mentioning is what Microvitec refers to as the "color express enhanced" warranty. In addition to the typical 1-year parts and labor coverage, this warranty promises replacement within 48 hours during the first 90 days after purchase, and Microvitec picks up the tab for shipping each way.

Because the monitor comes with such thorough warranty coverage and features such capable performance, it should come as no surprise to learn that it is one of the more expensive 14-inch multi scanning monitors we reviewed. Still, the price tag shouldn't deter business buyers whose applications demand a versatile, high-quality display.—**Frank Bican**

MITSUBISHI ELECTRONICS AMERICA INC.

Diamond Scan 14

If you're looking to display a wide variety of signals, Mitsubishi's Diamond Scan 14 AUM-1381A ($889) may be the monitor for you. Not only will this Japanese-made unit handle all IBM-standard video signals except 8514/A, it can display Mac II and even composite video (VCR) signals. Should you need particularly rich visual stimulation, the Diamond Scan can put two different types of signals on-screen at once.

Apart from its ability to display composite video images, however, little else distinguishes the Diamond Scan. The size of its white-beige case is average—12¾ by 14¼ by 14¾ inches (HWD) (the height is low only because a user-installable tilt/swivel stand is optional [$30]). The picture tube is the standard 14-inch size, with a 10¾- by 8-inch (13-inch diagonally) viewing area. The monitor's synchronizing range, however, is above average: it accepts vertical scanning frequencies of 45 to 90 Hz and horizontal frequencies of 15.6 to 36 kHz. It also handles separate sync, composite sync, and sync-on-green signals.

The Diamond Scan 14 is not equipped with true autosizing capabilities, but it can automatically size all the IBM VGA modes quite effectively, maintaining a constant image size. The horizontal size control, however, does not have enough range to fill the screen, so the image folds over about ¼ inch before the left screen edge and cuts off just inside the right edge of the bezel. The best image we could get measured 10 by 7⅛ inches (12⅜ inches diagonally).

Like most multiscanning displays, the Diamond Scan 14 is rated to handle an image resolution of 800 by 560 pixels. Though the monitor has no difficulty displaying 800 by 600, images produced at this resolution are inexplicably shifted so far to the right that they are partially off-screen. Although you can easily compensate for this shift by using the horizontal positioning control, you won't want to switch between VGA and 800 by 600 modes very often. Images at 800- by 600-pixel resolution are close to the size produced in the IBM VGA modes, but they have a slightly taller aspect ratio.

In general, the image that Mitsubishi's monitor produces is acceptable. It reveals no obvious geometric distortion, and its convergence rates as among the best of the displays evaluated here. A trace of shadowing (thin, dark, vertical stripes) is ap-

PC MAGAZINE FACT FILE

Diamond Scan 14
Mitsubishi Electronics America Inc.
Information Systems Division
991 Knox St.
Torrance, CA 90502
(213) 217-5732
List Price: With DB-9 connector cable, $889. DB-15 or Mac II connector cable, $35 extra. Optional tilt/swivel stand, $30.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: This Japanese-made 14-inch monitor produces acceptable images and displays a wide range of signals, including composite video.

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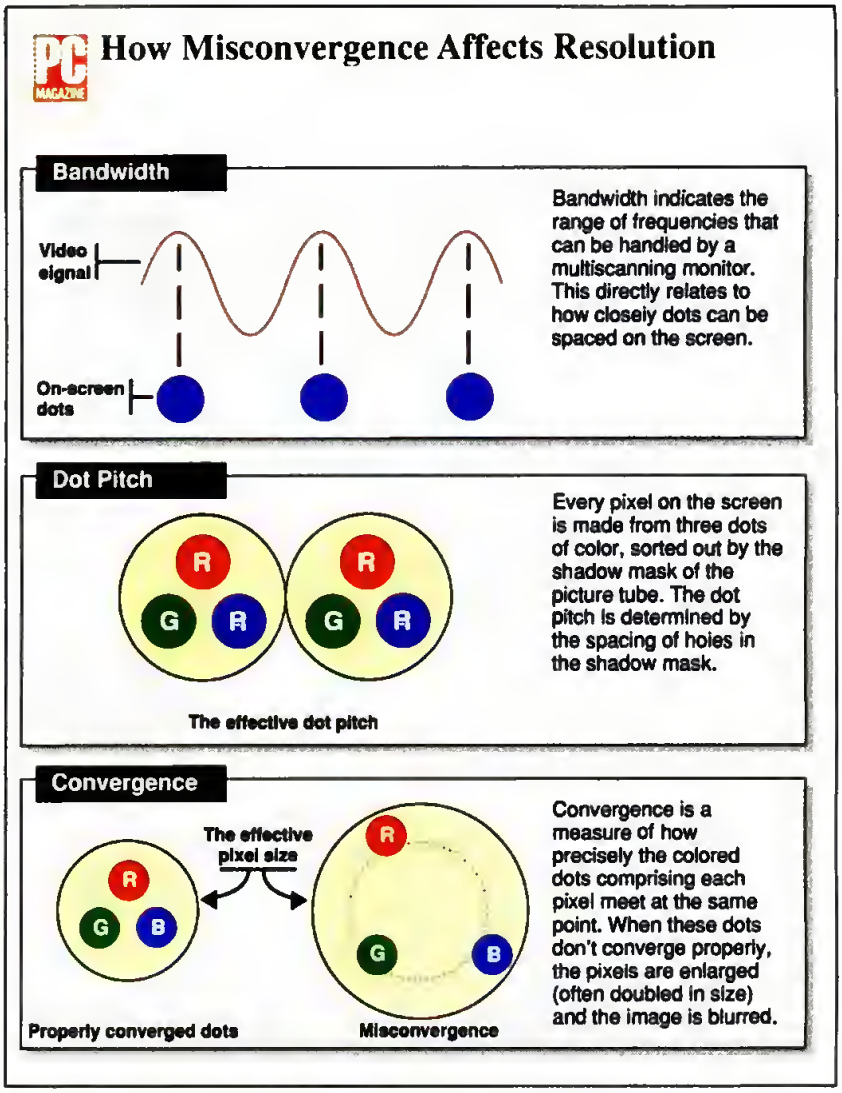
FACTORS AFFECTING RESOLUTION: CONVERGENCE SETS THE LIMIT

The sharpness of a color monitor's image is typically determined by three factors: the monitor's bandwidth, its dot pitch, and the accuracy of its convergence. While its bandwidth and dot pitch are what determine how good the monitor might potentially be, its convergence establishes how good the monitor actually is.

BANDWIDTH The bandwidth of a monitor is the range between the lowest and highest signal frequencies that its circuits can handle. This frequency range determines what resolution the monitor can display. Most bandwidth figures do not represent absolute capabilities, but rather indicate the range at which the monitor achieves optimal operation. The visual effect of modestly exceeding the rated bandwidth of a monitor is a slight softening of the sharp edges of each pixel.

To estimate the absolute minimum bandwidth that a monitor needs to be able to display a given graphic standard, you need to know the number of pixels and the frame rate associated with the standard: the bandwidth is approximately equal to the total number of pixels (the number of horizontal pixels multiplied by the number of vertical pixels) multiplied by the frame rate. (This calculation assumes that each pixel represents a signal pulse.)

In the case of 800 by 600 graphics, where the frame rate is 60 Hz, this calculation gives you a bandwidth of 28.8 MHz. This figure is actually low—in reality there is some necessary overhead, such as the time required for horizontal and vertical retrace (the time it takes the monitor's circuitry to shift from the end of a line to the beginning of the next line, and from the bottom of one frame to the top of the next). A 30-MHz system is thus barely adequate for 800- by 600-pixel graphics.



DOT PITCH All monitors come with dot pitch specifications, a measure of pixel spacing given in millimeters. Each pixel on a color screen consists of a trio of dots with each dot glowing in one of the primary colors of light: red, green, or blue. The pitch is determined by the spacing of the holes in what is called the shadow (or slot) mask of the monitor's cathode ray tube (CRT). Most of the 12- to 14-inch monitors reviewed in this article have a dot pitch of between .3 and .4mm; .31mm is a common dot pitch. The smaller a monitor's dot pitch rating is, the sharper the on-screen image it can display.

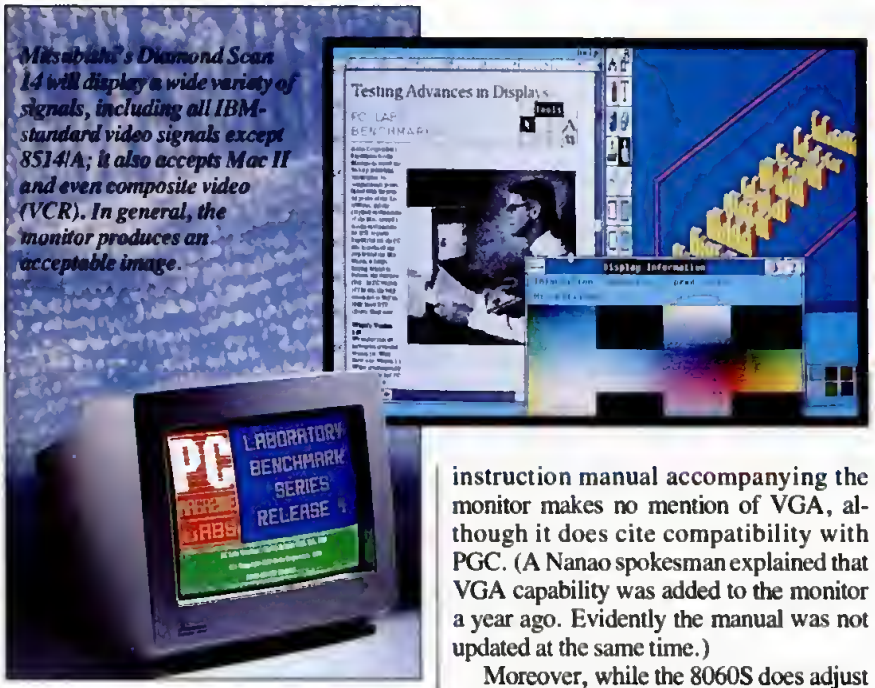
CONVERGENCE Convergence defines how accurately each of the three colored dots in a pixel is placed in relationship to the other two. In theory, the three electron beams that scan across the inside of the CRT to create the monitor's image should converge on a single point. In reality, they must be offset somewhat because the three phosphor colors of the tube are next to rather than on top of each other.

When convergence is perfect and all three guns are exciting the phosphor, the result is a pixel that appears perfectly white. A number of factors conspire against this perfection: small irregularities in the electronics that control each color gun, tiny differences in the alignments of the guns, variations in the magnetic fields that guide the electron beams. The result is that one or two colors may stray from ideal positioning, giving the pixels a distinctly two- or three-color look. Because of the spread of the dot trios, the image also loses sharpness and resolution. The misconvergence results in a loss of true white (and black) onscreen, causing text to appear fuzzy.

Convergence problems are not monitor design flaws, but rather the result of real-world imperfections. For this reason, the convergence of monitors of the same make and model varies. Convergence may even vary across the face of a screen. (Because electron beams are more difficult to control near the corners of the image, convergence problems usually arise there.)

Convergence errors are often the chief limitation on a particular monitor's resolution. For example, some monitors in this review are rated to have a maximum convergence error of .6mm—twice the dot pitch of the CRT tube. This causes poor image quality, particularly at the higher resolutions, where more information is being sent to the screen.

—Winn L. Rosch



Mitsubishi's Diamond Scan 14 will display a wide variety of signals, including all IBM-standard video signals except 8514/A; it also accepts Mac II and even composite video (VCR). In general, the monitor produces an acceptable image.

parent on the left edge of color bars, however. Additionally, Mitsubishi uses a special dark, high-contrast glass in its picture tubes to increase contrast. This glass gives a greenish-black look to the antiglare-treated screen, and though colors do stand out distinctly from the background, intensified colors on the IBM palette have a definite pastel cast.

Mitsubishi includes a 25- to 9-pin cable for TTL signals with the Diamond Scan. (The cable included with the evaluation system measured 48 inches. Cables for VGA or Mac II systems cost $35.) The monitor is FCC Class B certified.

The Diamond Scan 14 is an acceptable but not exemplary display. Choose it for its ability to handle composite video signals.

—Winn L. Rosch

NANAO USA CORP.

Nanao 8060S

A rather dated monitor, Nanao USA Corp.'s 8060S ($939) is so well made that it remains competitive. Though 2 years old, the display features one of the most tightly converged images found in the monitors reviewed in this issue.

The 8060S shows its age in the way it handles the 2-year-old VGA standard. The instruction manual accompanying the monitor makes no mention of VGA, although it does cite compatibility with PGC. (A Nanao spokesman explained that VGA capability was added to the monitor a year ago. Evidently the manual was not updated at the same time.)

Moreover, while the 8060S does adjust image size for earlier IBM standards, autosizing VGA signals—not to mention 800-by 600-pixel images—proved out of its ken. Although the monitor is able to display an image at the latter resolution (it claims a maximum resolution of 820 by 620), it measures 8 inches wide by 8⅛ high before being adjusted.

The Nanao 8060S has one of the most tightly converged images of the monitors reviewed here.

The 8060S does produce very sharp images, thanks to its exemplary convergence and the .28mm dot pitch of its display tube. It produces no visible geometric distortion, and colors stand out with good contrast and high purity against the nearly black matrix of the antiglare-treated display tube. The image is quite dim, however, and adjusting the brightness control to



Though it is 2 years old, Nanao USA Corp.'s 8060S monitor displays very sharp, tightly converged images. Autosizing VGA signals—not to mention 800- by 600-pixel images—proved out of its ken, however.

PC MAGAZINE FACT FILE

Nanao 8060S
Nanao USA Corp.
23510 Telo Ave., #5
Torrance, CA 90505
(213) 325-5202
List Price: $939 (DB-9 connector cable and DB-15 adapter included).
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: A somewhat dated, but still competitive Japanese-made 14-inch monitor, though it's relatively expensive.
CIRCLE **410** ON READER SERVICE CARD

maximum causes discernible character blooming.

At 15¾ by 14 by 15 inches (HWD), including a built-in tilt/swivel base, the white-beige 8060S appears somewhat chunky. Its gray-beige bezel masks the 14-inch display tube down to 13 inches. While the evaluation unit displayed only an FCC Class A certification sticker, Nanao received Class B certification for the 8060S in January 1989. Nanao supplied both a 63-inch 9- to 9-pin cable and a 78-inch 9- to 15-pin cable. The monitor's 70-inch power cord is not removable.

Brightness, contrast, horizontal and vertical size, and text-color thumbwheel controls are all located under the front-panel bezel. The vertical size control is detented in the center; the horizontal size control is actually a four-position switch. Optimum aspect ratio with the height control at its detent can be achieved with the minimum width setting, producing a 1.4 aspect ratio on VGA text-mode images. The 8060S does a good job of maintaining the width of VGA images at a constant 9⅛ inches. Height varies widely, however, from 5⅜ inches in 350-line mode to 6¼ inches in 480-line mode.

The monitor's text-color switch offers three modes: normal, amber (on black), and black-and-white. The last of these actually turned VGA color images pastel, although the monitor is meant to operate only in digital modes. It can deliver 8-color, IBM 16-color, AT&T 16-color, or 64-color modes. It handles separate sync, composite sync, and sync-on-green signals.

If you want to stick with a single mode, the 8060S will produce some of the best, although somewhat dim, images available. It is not a monitor to choose, however, if you switch often between text and graphics or between different operating resolutions.—**Winn L. Rosch**

NEC HOME ELECTRONICS (USA) INC.

NEC MultiSync Plus

From the company that's made the name MultiSync nearly interchangeable with multiscanning comes perhaps the finest "almost-everything-compatible" monitor yet made: the MultiSync Plus. Featuring the ability to display 1,024- by 768-pixel resolution images, the monitor's only real drawback is its price of $1,399, more than twice those of the least expensive monitors reviewed in this article.

NEC produced the first multiscanning monitor (the original MultiSync) 3½ years ago, following it with the MultiSync II, a superb VGA-compatible unit. The current MultiSync Plus not only lives up to its manufacturer's claims—and our expectations—but actually goes beyond them. NEC posts its monitor's maximum resolution at 960- by 720-pixels, yet our review unit was rock-steady when handed the Video Seven V-RAM VGA board's 1,024- by 768-pixel, noninterlaced, monochrome *Windows* display mode—a claim that can't be made for any other monitor we tested. And the display quality is so good that it nearly rivals that of an Amdek Monitor/1280, a paper-white monochrome system (1,280 by 800 resolution).

Many of the qualities of the MultiSync Plus's image are pleasing. Its clarity is impressive: it is just as sharp in the corners as in the center of the screen, and there is no hint of linear distortion along the outer edges of the display, a problem that plagues so many other monitors. In addition, the display's automatic image-size circuitry works so well that no adjustment is required to maintain a constant screen

EDITOR'S CHOICE

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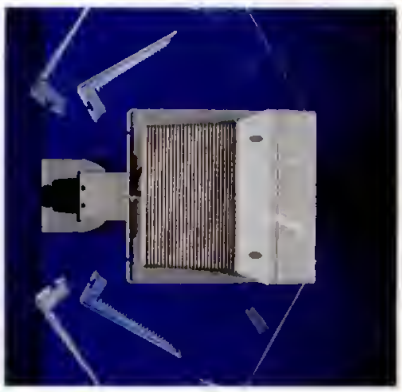
NEC MultiSync Plus
NEC Home Electronics (USA) Inc.
1255 Michael Dr.
Wood Dale, IL 60191-1094
(312) 860-9500
List Price: With DB-15 connector cable, $1,399. DB-9 connector cable available at no extra charge.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: Quite simply, the very best 14-inch color multiscanning monitor available; unfortunately, its price is high enough to keep many of us from enjoying it. Capable of resolutions as high as 1,024 by 768 pixels without resorting to interlacing.
CIRCLE **411** ON READER SERVICE CARD

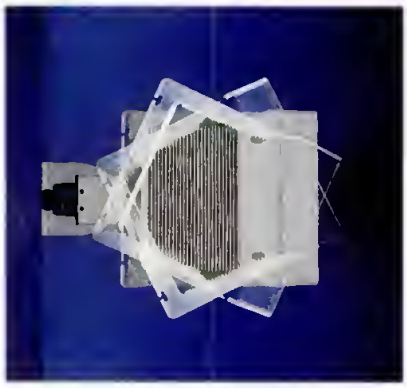
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NEC'S NEW MULTISYNC MONITORS

In February, a little more than a year after it introduced the popular MultiSync II, which had the number 1 market share among VGA-capable monitors, NEC stopped producing it. In its stead, the originator of the multiscanning monitor is offering two new MultiSyncs: the 2A and the 3D. We were able to examine a preproduction version of the 3D and an FCC-approved production-model MultiSync 2A.

Though they look nearly identical, sporting a new, smaller, almost Macintosh-like shape, these latest descendants of the MultiSync are actually quite different. NEC is positioning the $1,049 3D as the replacement for the $949 II; at the same time, it's grooming the $799 2A as a competitor in the fixed-frequency VGA market.

Like its predecessors, the 3D can accept a wide range of signals (horizontal frequencies of 15.5 to 38 kHz), both analog and digital. The 2A, on the other hand, is actually not a multiscanning monitor at all, at least not in the spirit of the other monitors bearing the MultiSync trademark. The 2A monitor is analog only: it accepts no TTL signals, making it incompatible with MDA, CGA, or EGA graphics cards (it can display the resolutions associated with each of these standards if they are generated by an analog adapter). NEC's 2A is, in fact, a dual-fixed-frequency monitor, operating at horizontal scanning frequency synchronizations of either 31.5 kHz (for VGA mode) or 35 kHz (for Super VGA) and nothing more.

Although capable of displaying images with true-looking color and sharp characters at both VGA and Super VGA resolutions, the preproduction MultiSync 3D proved unable to display noninterlaced 1,024 by 768 resolution, though it is rated as being able to accommodate 8514/A-compatible interlaced 1,024 by 768. (Despite its rated limit of 960- by 720-pixel resolution, the top-of-the-line MultiSync Plus reviewed in this issue was able to display noninterlaced "1K" resolution.) Instead of the shaft-style controls used to adjust positioning on the older MultiSync models, the 3D sports front-mounted, push-button, digital controls that worked well in the preproduction model.

MULTISYNC OR NOT? The 2A, when compared with the higher-end multiscanning monitors in this roundup, performed adequately. Compared with the Taxan MultiVision 770 Plus, its color was not as vivid and its characters were not as crisp. It seems fairer, however, to compare the 2A to a fixed-frequency VGA monitor, since that's how NEC is positioning it. For this reason, we put the 2A and IBM's most popular monitor, the 8513, head-to-head, and the results are clear.

Because of the 2A's rather lifeless red hues, the 8513 has slightly better color. And even though the 2A suffers from some color washout, both demonstrate good color shading and gradation. In terms of resolution, however, the 2A performs far better than its IBM counterpart. With a screen more than 2 inches larger (13.25 inches in diagonal, compared with the 8513's 11 inches), a better screen mask, and more-finely drawn characters, the 2A is capable of displaying much clearer text. This is true both in text and in graphics applications such as Microsoft *Windows*. The 2A also possesses excellent screen controls, the bulk of which are located on the front of the machine under its screen.

The 2A's $799 price tag makes it a highly competitive challenger to the IBM 8513 VGA monitor, which lists at $750 and does *not* offer Super VGA resolution. The 3D, on the other hand, looks as if it will appeal to anyone interested in a multiscanning monitor capable of 800 by 600 resolution. But if you still want a MultiSync II, you can probably still find one—if you hurry.

—Kellyn S. Betts and Matt Ross

size when switching among the VGA display adapter's many video modes.

Though pleasing, the image produced by this monitor is not perfect. Its colors, while quite acceptable, seem a bit washed out compared to those of several of the other units. The effect was particularly pronounced in the lighter shades of red, magenta, and yellow. And even with the horizontal- and vertical-image size controls set to their maximums, the image is rather on the small side, measuring just 11¾ inches diagonally. As a result, there's a fairly large (approximately ¾ inch) black border.

The monitor's cabinet is a typical product of NEC's design efforts (meaning that it's a bit boxy looking), but it still would serve well as an ergonomic model for other manufacturers to follow. The power, brightness, and contrast controls are mounted on the left front of the case, while most of the other, less frequently used controls are mounted behind a door at the left-front edge.

The NEC MultiSync Plus is perhaps the finest almost-everything-compatible monitor yet made.

The MultiSync Plus performed acceptably on our glare tests, but even subjectively it doesn't appear to reflect much background light. This subjective rating is important because the tilt/swivel base on our review unit suffered from a fairly high degree of friction, necessitating a firm, two-handed shove to adjust it.

NEC has equipped the MultiSync Plus with the most complete array of input connectors of any of the monitors we reviewed, including the usual DB-9 connector (for TTL or analog signals), as well as



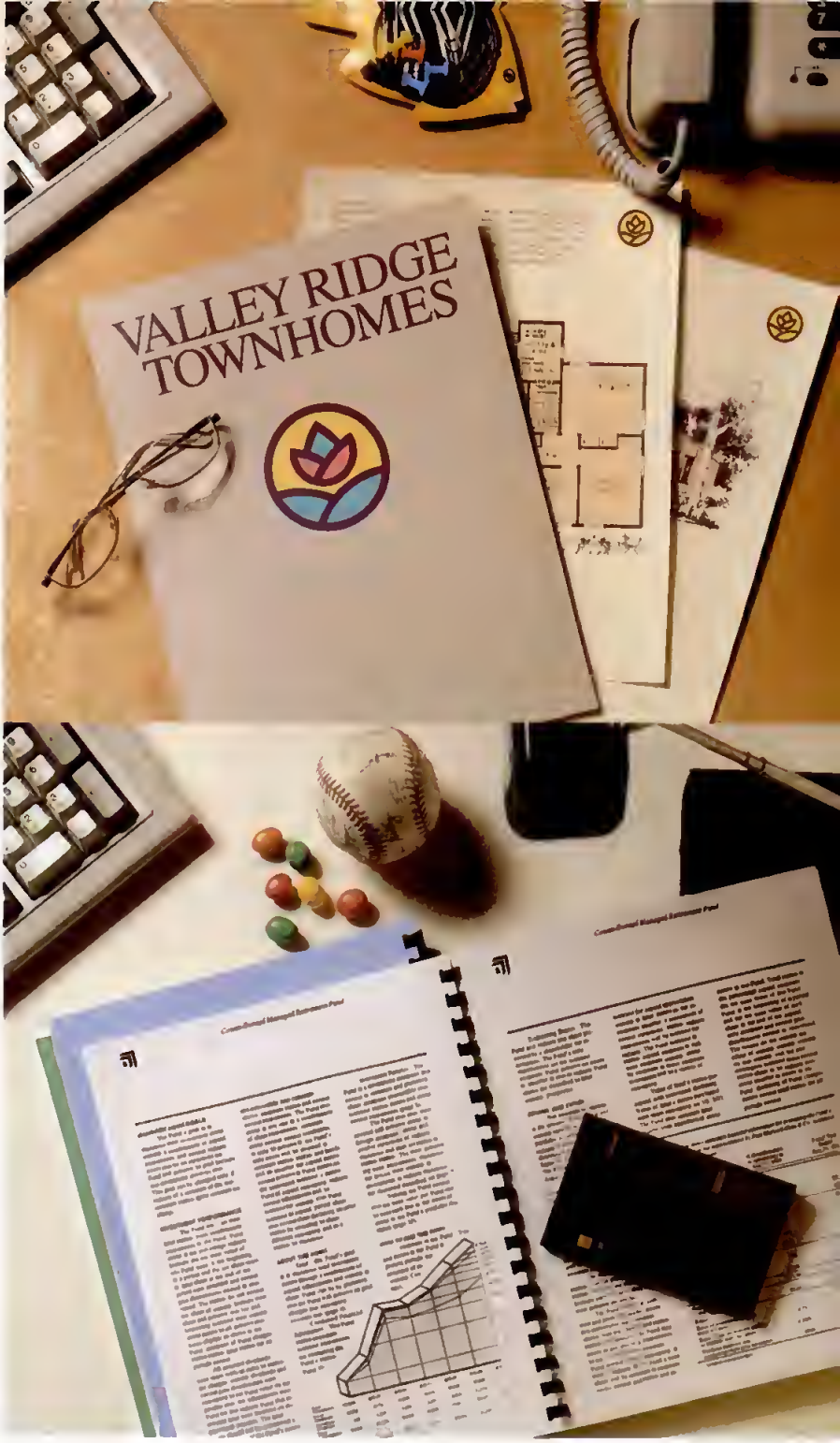
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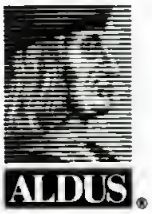


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The only monitor of this bunch capable of displaying 1,024- by 768-pixel resolution images, the NEC MultiSync Plus's only real drawback is its price: $1,399. But the clarity of the monitor's image is impressive, it shows no linear distortion, and its automatic image-size circuitry works very well.

separate-sync and composite BNC connectors. Two cables come with the monitor, one for the VGA's 15-pin connector and one for the 9-pin connector found on most other video boards, such as the EGA. Custom cables are required, however, to use the BNC connectors.

Despite minor problems, the performance of the MultiSync Plus definitely makes it the monitor to beat. It's easier to beat its price tag; nevertheless, for the last word in versatility and image quality, the MultiSync Plus is the monitor to own. **—Frank Bican**

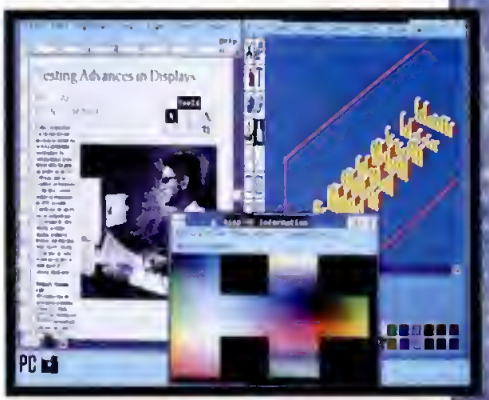
PRINCETON GRAPHIC SYSTEMS INC.

Princeton Ultrasync

If it's true that good things come in small packages, then Princeton Graphic Systems' Ultrasync is doubly good. Not only is the monitor phyisically small, its $849 price can also be described as diminutive. But don't think for a minute that this bantamweight's performance can't keep up with that of its heavyweight brethren.

Advertised as measuring 12 inches, the Ultrasync's display viewing area is actually a slightly smaller 11½ inches diagonally, making it the smallest of the monitors included in our review. The Ultrasync's display screen benefits from an extremely fine .28mm dot pitch, which helps it maintain image clarity, compensating for its smaller size. Our review unit, however, suffered from a slight case of misconvergence of the red color gun along the right side of the screen, giving characters there reddish shadows.

Its accurate color reproduction is one of the Ultrasync's strong points: every color but brown (which has a slightly orange cast) is faithfully reproduced. Furthermore, the colors hold up well even as the brightness is turned up to levels that are uncomfortable to look at for long. At such high luminosity, though, black backgrounds tend to wash out to dark gray. To be fair, it is unlikely that anyone will require such brilliant color levels. A very slight amount of linear distortion (pincushion) can be detected along the vertical edges of the screen, but the horizontal lines remain absolutely straight.

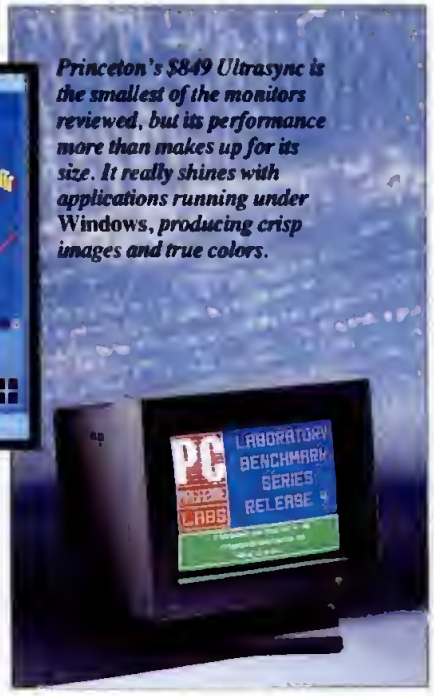


Where the Ultrasync really shines is with applications running under *Windows*. The video images are simply beautiful—crisp and colorful. The Ultrasync actually makes *PageMaker* sessions fun, even if you do have to squint occasionally.

Several monochromatic text modes can be selected by pressing a momentary-contact push button (most use a slide switch). The monitor cycles through white, cyan, green, and amber text (each on a black background), then goes back to full color operation. Although the white, green, and cyan modes are quite good, the amber has a very noticeable green tinge to it and isn't particularly pleasant to view.

In our acid tests, the Ultrasync handled all of the VGA video modes in exemplary fashion, thanks in part to its automatic image-sizing circuitry. When fed a diet of 800- by 600-pixel *Windows* images, however, the same circuit apparently goes out to lunch, since the horizontal image dimension shrinks to 7⁹/₁₀ inches, even with the manual control set at its maximum position.

From an ergonomic standpoint, the Ultrasync's design leaves something to be desired. Its various controls are located all over: On the left side of the cabinet are thumbwheels for brightness and contrast; the right side has the power and text-mode switches; and the image-size and- position controls are even less conveniently locat-



Princeton's $849 Ultrasync is the smallest of the monitors reviewed, but its performance more than makes up for its size. It really shines with applications running under Windows, *producing crisp images and true colors.*

PC MAGAZINE FACT FILE

Princeton Ultrasync
Princeton Graphic Systems Inc.
601 Ewing St., Bldg. A
Princeton, NJ 08540
(609) 683-1660
(800) 221-1490 (outside N. J.)
List Price: With both DB-9 and DB-15 connector cables, $849. Optional AC-100 connector cable for Mac II, $19.95.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: A lilliputian in a land of giants, the smaller size of the Ultrasync is reflected in its smaller price tag compared with many of its competitors.

CIRCLE 412 ON READER SERVICE CARD

ed, on the back. Perhaps these odd locations were dictated by the cases's size, but it sure would help if some of the controls could be moved to the front.

The Princeton Ultrasync seems a bit overpriced for its size, but a quick check of the mail-order ads in *PC Magazine* found several vendors offering it for just over $500. At that price, it suddenly seems a lot more appealing.—**Frank Bican**

RELISYS

Relisys RE5155

When *PC Magazine* last looked at VGA-compatible, multi-scanning monitors (May 31, 1988), Relisys's RE5155 was, to put it mildly, the one that was most forgettable. Happily, though the monitor still bears the same moniker, it appears that the folks at TECO (Relisys's Taiwan-based parent company) have been paying more attention to quality control.

The RE5155 we reviewed this year produced acceptable video images under most circumstances. The sharpness of the $795 monitor's character reproductions is quite high in the center of the screen, with only the faintest amount of softening in the extreme corners. There is no linear distortion and only an average amount of image blooming. Most of the colors in the VGA palette are reasonably accurate, with only the reds and browns lacking in zip (perhaps "muddy" would be a more fitting description). Even with the brightness and contrast controls at maximum, however, the brightness of the image is merely adequate: all of the colors would probably benefit if the monitor were brighter.

Most of the RE5155's controls are located under a small plastic door on the right side of the cabinet. While not as convenient as front-mounted controls, they certainly are easier to use than those on the back of a monitor, a location inexplicably favored by so many manufacturers.

The few controls located on the back of the monitor are not likely to be used often: TTL/analog mode and auto/manual scan switches, as well as deeply recessed DIP switches for 8/16/64 color modes and for selecting red, green, or blue text-mode colors. These will be of interest only to owners of TTL adapter boards (such as the EGA), because analog operation is strictly full-color.

One control that could benefit from an engineering modification is the horizontal size switch. Its two positions varied the horizontal image measurement by just ¼ inch in all modes. The largest image possible is 9.1 inches (except in 800 by 600) across, resulting in nearly 1 inch of wasted space on each side of the screen. This inadequacy becomes all the more noticeable when running an 800- by 600-pixel *Windows* application: image size shrinks to just 8.7 inches horizontally because the monitor loses its ability to autosize at that resolution.

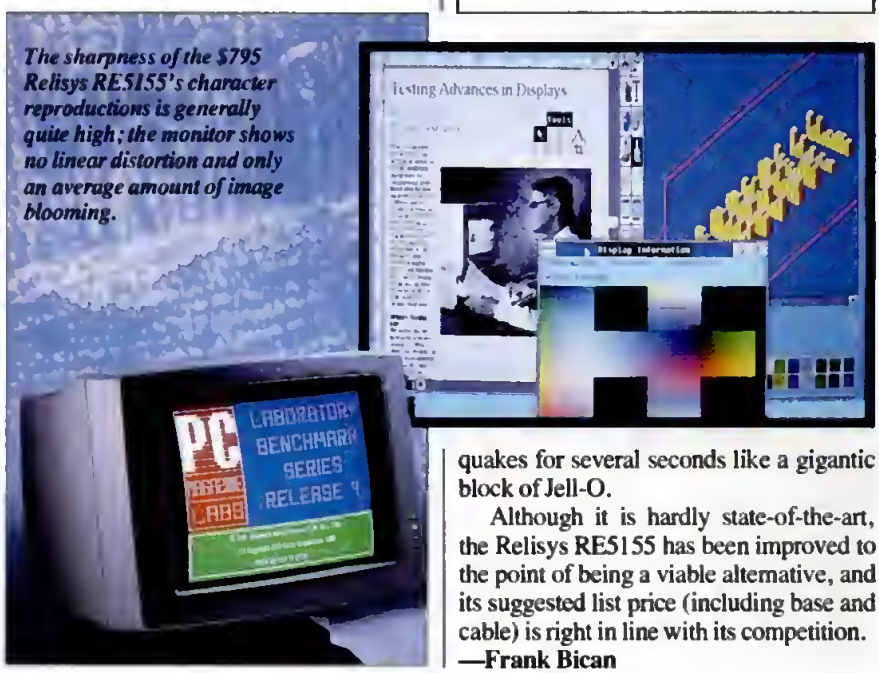
Although attractive, the RE5155's cabinet is marred by two design flaws that Relisys would do well to correct. The plastic door over the right-side-mounted controls appears to be as vulnerable to breakage as Waterford crystal in the grasp of a toddler. Additionally, the tilt/swivel base exhibited a disconcerting amount of flexibility: move the monitor and the entire cabinet quakes for several seconds like a gigantic block of Jell-O.

Although it is hardly state-of-the-art, the Relisys RE5155 has been improved to the point of being a viable alternative, and its suggested list price (including base and cable) is right in line with its competition.
—**Frank Bican**

PC MAGAZINE FACT FILE

Relisys RE5155
Relisys
320 South Milpitas Blvd.
Milpitas, CA 95035
(408) 945-9000
List Price: With DB-9 and DB-15 connector cables standard, $795.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: Since the last time it was reviewed, the RE5155 has improved to the point that it can now be recommended without reservation. Some additional rigidity could still be used in the tilt/swivel base, however.

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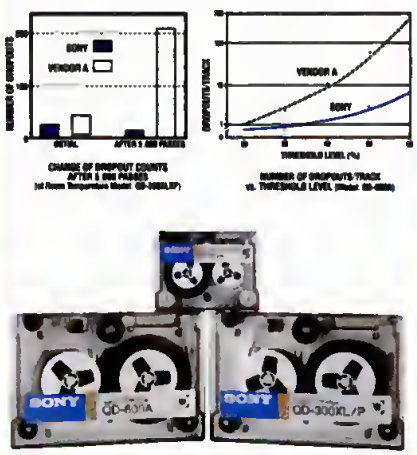
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SAMSUNG ELECTRONICS AMERICA (SEA) INC.

Samsung Sync Master CN4551

Another member of the growing class of generic multiscanning displays, Samsung Electronics America's $699 Sync Master CN4551 delivers almost everything you'd want in a color monitor without excelling in any particular area.

The quality of the image on the Sync Master's nearly black, antiglare-treated screen is very good. All colors, including brown, match the IBM palette. Image geometry is very good, and convergence is worse than the .31mm dot pitch of the shadow mask tube only in the lower left screen corner, where the green beam was about .5mm low.

The Sync Master's autosizing capabilities work well: image height varies only slightly (about ⅛ inch) in any standard IBM video mode. In 800-line mode, however, it overcompensates, reducing image height by about ¾ inch.

The Sync Master's biggest drawback is its inability to let you adequately manipulate horizontal image size. Instead of a knob, it has a two-position slide switch that has a barely perceptible effect. As a result, you are restricted solely to the image width determined by the factory, which—when adjusted to yield a nominal 1.33 aspect ratio—measures about 9¾ by 7⅜ inches (12⅜ inches diagonally).

The Sync Master is about the same size

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Samsung Sync Master CN4551
Samsung Electronics America (SEA) Inc.
301 Mayhill St.
Saddle Brook, NJ 07662
(201) 587-9600
List Price: With both DB-9 and DB-15 connector cables, $699.
Requires: CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: A low-priced Korean 14-inch display with autosizing, it delivers almost everything you'd want in a color monitor.
CIRCLE 417 ON READER SERVICE CARD

Performance Tests: Multiscanning Monitors

These glare-test readings were normalized against the IBM Model 8513, one of the most popular VGA monitors sold with the PS/2 line. For comparison, we have also included glare-test results for the Compaq Video Graphics Color Monitor and the Zenith ZCM-1490. The Zenith monitor is far superior to all others on the market in its resistance to glare, because of its dark two-layer screen, antiglare etching, and flat tension mask.

Of the multiscanning monitors reviewed, the Sony CPD-1302 made its way to the top of the list by virtue of its dark screen coating and relatively flat tube. But the Sony, Taxan, Diamond Scan, and Tatung monitors are all so close in glare resistance that you would be hard pressed to notice the difference among them.

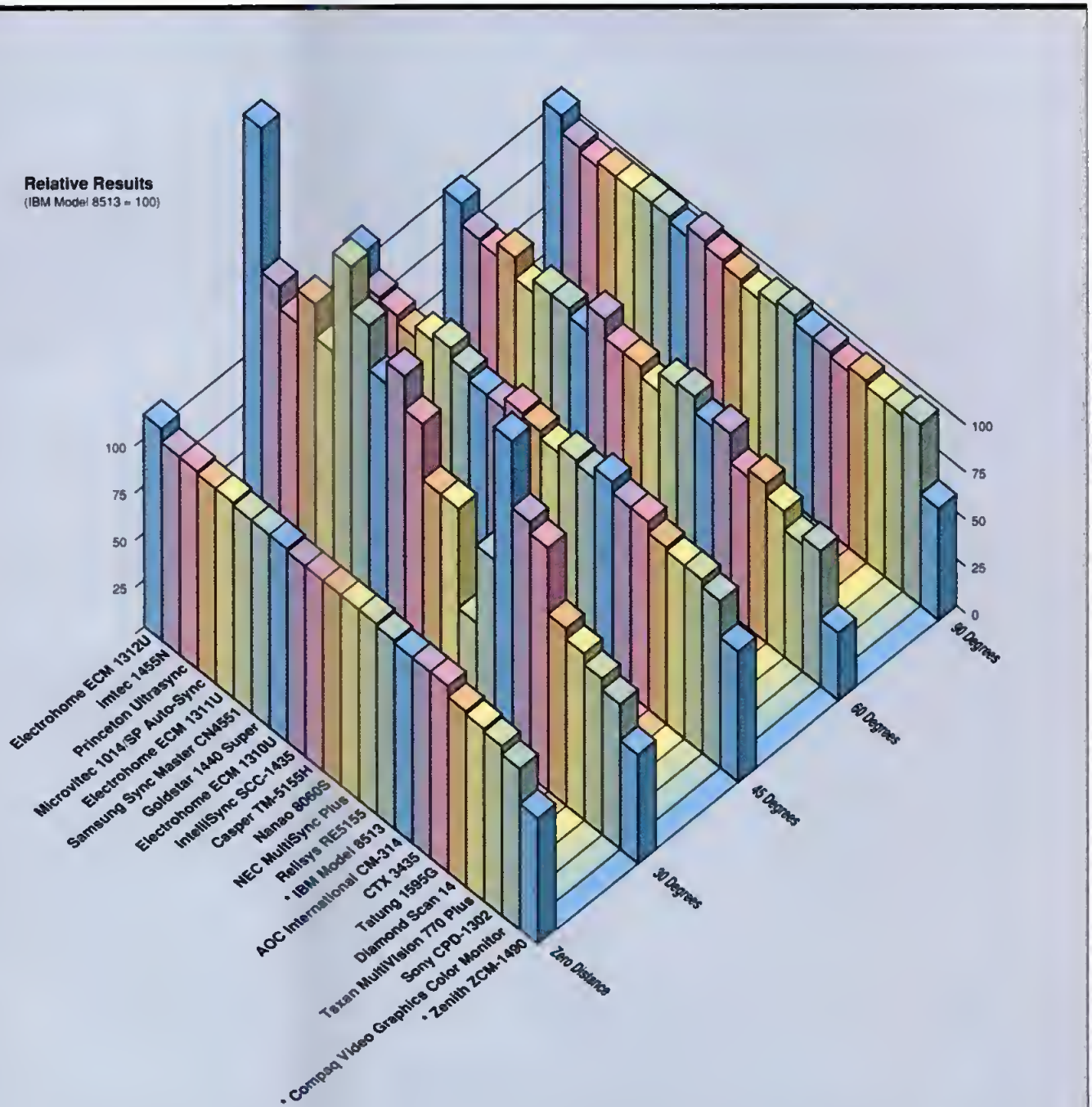
The many monitors with midrange glare-test scores were pretty evenly matched. They were handicapped either by a light screen coating or by the lack of an etched screen to diffuse reflected light.

At the bottom of the pack was the Electrohome ECM 1312U. Its light gray coating and clear, unetched screen combined to produce worse-than-average glare readings across the board.

Monitor Glare
(Actual light readings given in percent of reflected light)

	Zero Distance	30 Degrees	45 Degrees	60 Degrees	90 Degrees
Electrohome ECM 1312U	15.8%	39.0%	62.0%	74.0%	81.0%
Imtec 1455N	14.8%	26.0%	54.0%	66.0%	74.0%
Princeton Ultrasync	14.8%	24.0%	53.0%	65.0%	72.0%
Microvitec 1014/SP Auto-Sync	14.6%	27.0%	51.0%	70.0%	74.0%
Electrohome ECM 1311U	14.6%	24.0%	54.0%	62.0%	74.0%
Samsung Sync Meeter CN4551	14.4%	33.0%	56.0%	67.0%	75.0%
Goldstar 1440 Super	14.4%	29.0%	53.0%	67.0%	75.0%
Electrohome ECM 1310U	14.4%	25.0%	51.0%	64.0%	73.0%
IntelliSync SCC-1435	14.2%	27.0%	51.0%	74.0%	77.0%
Casper TM-5155H	14.2%	24.0%	54.0%	67.0%	75.0%
Nanao 8060S	14.2%	19.0%	53.0%	67.0%	73.0%
NEC MultiSync Plus	14.2%	19.0%	51.0%	63.0%	71.0%
Relisys RE5155	14.2%	10.0%	53.0%	70.0%	74.0%
* IBM Model 8513	14.0%	17.0%	52.0%	72.0%	76.0%
AOC International CM-314	13.8%	29.0%	55.0%	66.0%	73.0%
CTX 3435	13.8%	23.0%	52.0%	69.0%	73.0%
Tatung 1595G	13.8%	22.0%	52.0%	58.0%	71.0%
Diamond Scan 14	13.0%	16.0%	49.0%	61.0%	73.0%
Taxan MultiVision 770 Plus	12.8%	15.0%	48.0%	56.0%	71.0%
Sony CPD-1302	12.6%	14.0%	48.0%	49.0%	71.0%
* Compaq Video Graphics Color Monitor	12.0%	13.0%	46.0%	52.0%	73.0%
* Zenith ZCM-1490	9.4%	9.8%	36.0%	26.0%	45.0%

* These products were not reviewed, but we ran tests on them for comparison, as described in the caption



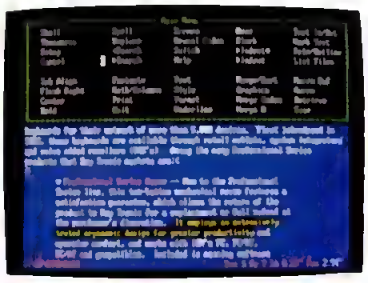
The **Monitor Glare** test simulates different lighting conditions by placing diffused spotlights at 30-, 45-, 60-, and 90-degree angles to the monitor screen. The 30-degree angle simulates an overhead light, the 45- and 60-degree angles, a desk lamp; and the 90-degree angle simulates direct light from a window.

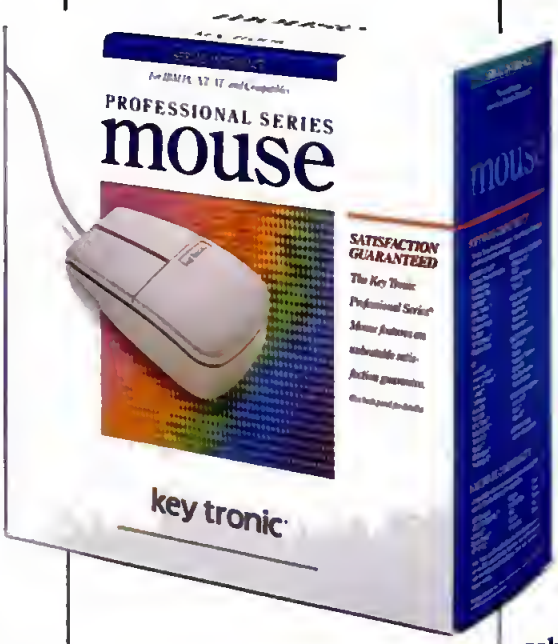
The percentage of the original light energy that bounces back off the screen is measured with a spot meter. (For reference, a matte black surface, which provides maximum glare resistance, gives a reading of 4 percent, while a mirror, with minimal glare resistance, reflects 96 percent of the light.)

Additionally, a zero-distance reading is taken using a reflecting densitometer. This device, similar to a spot meter, is placed directly on the screen surface and uses an internal light source as the basis for measuring reflected light. The results of this reading are indicative of the screen's reflectivity, eliminating the effects of screen curvature.

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Of course, the Professional Series Mouse also operates with literally hundreds of other software programs: from desktop publishing, to CAD, to graphics.

The Editor's Choice Is The Smart Choice.

Great care went into the design and engineering of the Professional Series Mouse. In fact, *PC MAGAZINE* had many flattering things to say in its February 14, 1989, issue (page 252), when it issued the Editor's Choice Award to the Professional Series Mouse. *"Well designed, carefully documented, and an exceptional value,"* was how that publication summed it up.

PC MAGAZINE EDITOR'S CHOICE

The Price Is Right.

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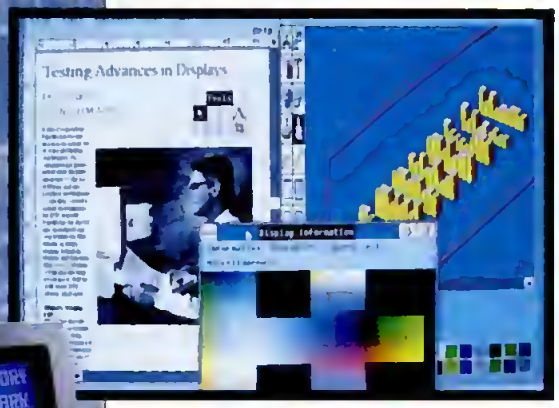
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CIRCLE 214 ON READER SERVICE CARD



Samsung's $699 Sync Master CN4551 delivers almost everything you'd want in a color monitor: the quality of its images is good and its autosizing capabilities work well. Its biggest drawback is its inability to let users adequately manipulate horizontal image size.



as most displays in its class—14¾ by 14¼ by 14¾ (HWD) inches on its built-in tilt/swivel stand—but it looks bulkier because the rear of its white-beige case tapers less than most. The front-panel bezel reveals slightly more of its 14-inch display tube than do those of most monitors: a 13⅜ inch diagonal swath measuring 11 by 8¼ inches. Shielding in the plastic case is good enough to earn an FCC Class B certification.

Contrast and brightness controls are thumbwheels tucked under the left edge of the front bezel. Although the contrast control has a center detent, this setting results in a screen too dark for most viewing situations, even when you crank the brightness control to the top of its range.

The rest of the monitor's controls are on its rear panel. Shafts allow the adjustment of vertical image size and position and horizontal image position. Horizontal sizing is left to the inadequate two-position slide switch mentioned above. A note of caution: When we manipulated the horizontal position control, the video beam was cut off about ½ inch before the edge of the screen, the image squashing into a bright vertical line on the left edge of the display.

Although the Korean-made set claims only 800- by 560-pixel display abilities, it easily handles 800-by-600 video. The monitor's nondetachable power cord measures 5 feet in length. Samsung supplies both 9- to 9-pin and 9- to 15-pin video cables with the Sync Master. The cables that accompanied the evaluation unit measured 48 inches.

If you don't mind the Sync Master's inflexible image width—and considering the lack of adjustment found on ordinary VGA monitors, you may not find that to be a problem—it's not a bad choice among generic multiscanning displays.

—Winn L. Rosch

SONY CORP. OF AMERICA INC.

Sony CPD-1302

Having made its name almost synonymous with premium quality by virtue of its excellent television sets, Sony Corp. of America has every reason to believe that, as a product so obviously related to its flagship line, its monitors would benefit from the company's sterling reputation. Sony's $995 CPD-1302 monitor, however, has a few yards to go before it can properly be called state-of-the-art.

Nearly identical mask and phosphor technologies are used to create the images displayed on Sony televisions and Sony monitors. Ironically, the image characteristics that place Sony TVs above their competition put the CPD-1302 at a competitive disadvantage:

■ The striped pattern of rectangular phosphor dots (most monitors use a triangular arrangement of round dots) may create the illusion of sharpness in a lower-resolution TV image, but on a monitor it yields coarse-looking character images.

■ The large differences between the dot pitches of the screens' axes (along the horizontal axis, the dot pitch is .26mm; it's roughly twice that along the vertical axis) is perfectly acceptable when you're viewing a screen from 12 feet away. When the viewing distance is 24 inches, however, rectangular pixels leave something to be desired.

■ The striped pattern of the dots contributes to the rather soft edges between adjacent color bars on the PC Labs' monitor performance tests. Since the phosphor dots along the vertical axis measure a (relatively) large .52 mm, they tend to stand out when illuminated, thus creating a softening between the adjacent colors in the horizontal line.

As if the previously mentioned problems weren't enough, the CPD-1302 we reviewed displayed a bit of misconvergence of the red color gun at the upper-right-hand corner of the screen. Also, though the Sony's automatic image-sizing circuitry works fine when switching among the standard VGA modes, it isn't up to coping with an 800- by 600-pixel *Windows* display without help from its manual counterparts. The vertical size grows considerably and has to be scaled back, while the horizontal size shrinks by roughly ¾ inch and can't be entirely compensated for.

PC MAGAZINE FACT FILE

Sony CPD-1302
Sony Corp. of America Inc.
Computer Peripheral Products
One Sony Dr.
Park Ridge, NJ 07656
(201) 930-1000
(800) 222-0878
(800) 222-0879 (in N.J.)
List Price: $995; with cable and base, $1,045. DB-9 and DB-15 connector cables available.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: A good monitor that suffers from its manufacturer's continued devotion to the stripe mask rather than the more-common dot mask, which results in a somewhat coarser image than those of its competition.

CIRCLE 418 ON READER SERVICE CARD



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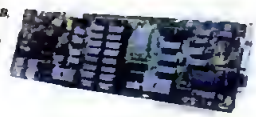
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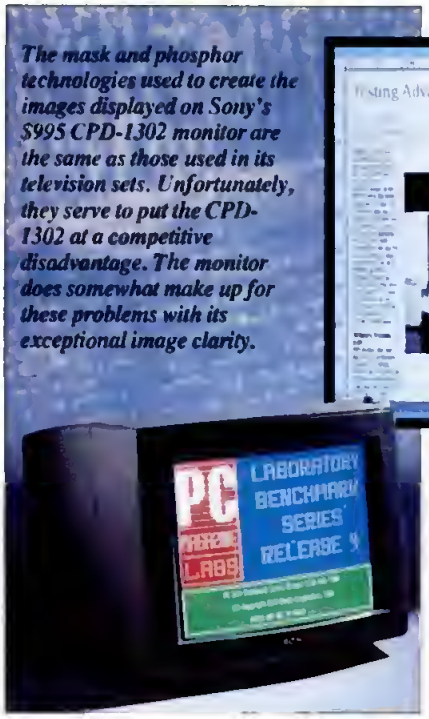
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CIRCLE 293 ON READER SERVICE CARD



The mask and phosphor technologies used to create the images displayed on Sony's $995 CPD-1302 monitor are the same as those used in its television sets. Unfortunately, they serve to put the CPD-1302 at a competitive disadvantage. The monitor does somewhat make up for these problems with its exceptional image clarity.

Notwithstanding all these problems, the CPD-1302 has a number of excellent display attributes that somewhat make up for what it lacks in terms of image clarity. Its colors are exceptionally accurate and rich in saturation, regardless of brightness level (which at its maximum, is dazzling), and the background always remains coal black. Only the slightest amount of image blooming can be detected when cycling from dark to light.

The positioning of the CPD-1302's controls is typical of the bulk of monitors we reviewed, with only the power, brightness and contrast controls mounted on the right side of the cabinet. The remaining controls reside on the back of the monitor behind a plastic cover, which is held in place by a friction catch and is sure to be lost in no time.

One unique attribute of the CPD-1302 is the shape of its screen. While the vast majority of monitor screens exhibit biaxial curvature to some degree, this one curves only along the horizontal axis—the vertical line is dead-straight. Coupled with screen etching, this feature holds background distractions to a minimum; it did quite well on our glare tests.

With a few modifications, the CPD-1302 could probably challenge the best monitors available. Even as is, it rates as an above-average selection.

—Frank Bican

TATUNG CO. OF AMERICA INC.

Tatung 1595G

Those looking for the widest-possible range of scanning frequencies as a hedge against obsolescence may find the $1,199 1595G from Tatung Co. of America tempting. Its horizontal range of 15–37 kHz and vertical range of 40–120 Hz are among the broadest offered by any of these monitors.

Advertisements for the 1595G boast of a 15-inch diagonal screen, making it the largest monitor in our test group. In truth, however, the monitor's display area measures 13½ inches, exactly the same as that of the NEC MultiSync Plus monitor. Perhaps the 1595G's picture tube is the largest, but when it's covered with a mile-wide bezel, it doesn't really matter. For all practical purposes, only the image on the diminutive Princeton Ultrasync (at just 11½ inches) is appreciably smaller.

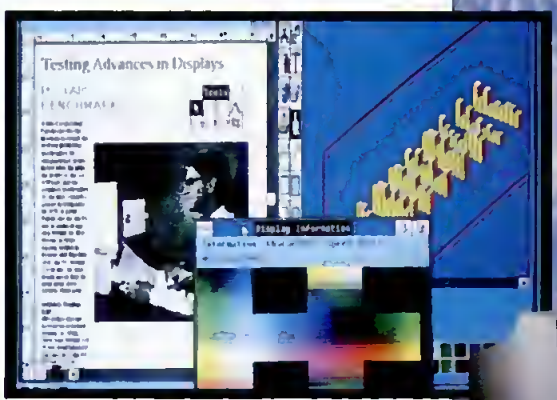
It's a shame that the Tatung monitor doesn't have sheer size to recommend it, because its performance is also a bit of a disappointment.

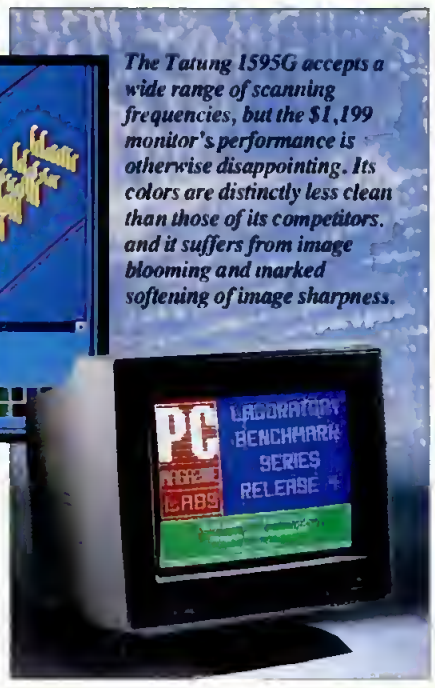
The 1595G's colors are distinctly less clean than those of its competitors, with white and yellow displaying a noticeable magenta cast. To its credit, the other colors retain relatively good saturation at high brightness levels, and the black background remained faithful.

Two other weaknesses became apparent with increasing image intensity: a moderate amount of image blooming, and marked softening of image sharpness, not just in the comers, but in the center of the screen as well.

Zipping between various video modes reveals a lack of automatic vertical-image sizing circuitry that many would expect to be standard on a $1,199 monitor. Horizontal image size is controlled by a two-position slide switch that varies the measurement by just .4 inch, for a maximum of 10.1 inches. The result is at least .5 inch of black space on either side of the screen.

Vertical size and image position are controlled by the potentiometer knobs which (along with all but one of the 1595G's controls—the 8/16/64 TTL color





The Tatung 1595G accepts a wide range of scanning frequencies, but the $1,199 monitor's performance is otherwise disappointing. Its colors are distinctly less clean than those of its competitors, and it suffers from image blooming and marked softening of image sharpness.

SIZABLE PROBLEMS

With a Super VGA card inside your PC, all you have to do to ensure that your multiscanning monitor will display different graphics standards is have the correct software drivers installed for the application you use. If you move from an application written for a VGA driver to one written for Super VGA, the 800 by 600 image you display will be perfectly proportioned, with that all-important 1.33 aspect ratio. As long as your monitor has decent autosizing capabilities, that is.

TORTURED IMAGES Capabilities like autosizing are easy to take for granted. But if you don't have them (and 11 of the 19 monitors we reviewed didn't), or if they don't work well, you are only too cognizant of their value. Without autosizing, each time you switch between graphics standards, you have to fiddle with your monitor's size control switches until the new image seems properly represented.

Before you make such adjustments, however, you might be treated to a Super VGA image that looks like it's been tortured on the rack instead of merely being converted from 640 by 480 VGA to 800 by 600. And moving from VGA to EGA might produce an image that would be so distorted it looks as if it's been squashed like a bug.

Without autosizing (short for automatic size adjusting) converted images are subject to such distortion because of the way that they are created by the monitor. In order to display an on-screen image, the electron gun in your monitor's tube is constantly scanning from left to right and from top to bottom, thus illuminating the horizontal lines of pixels at a constant rate.

It does all this in 1/60 of a second, and each line is being excited at a rate faster than the eye is able to perceive. Hence all of the lines appear to be excited simultaneously, thus allowing you to perceive the entire screen display as a cohesive image.

When you call upon your monitor to display an image at a different resolution, however, you change the number of horizontal lines it must scan across to create its image. In VGA graphics mode the display is comprised of 480 horizontal lines; in Super VGA, the number jumps to 600. The constant scanning rate (and thus the width per line) causes images with greater numbers of horizontal lines to stretch—in some cases out of view.

RECOGNIZE AND ADJUST To autosize images, a monitor needs to perform some pretty impressive calculations. It must recognize the frequency of the vertical synchronizing input signal by determining the period between the signal's pulses.

Once it has recognized the signal, the monitor adjusts both the sweep rate of its electron gun and the area that the gun must cover to display the number of horizontal lines associated with the standard recognized by that signal.

An interesting note: Many of these multiscanning monitors have automatic size adjustment capabilities only within the VGA standard, because they use an adjustment method designed by IBM for its fixed-frequency VGA displays. This method requires the video adapter to send a special code to the monitor to signal how many lines are in the image that is going to be displayed. The monitor detects this code and adjusts the image height to match the standard used by the display adapter.—**Robert W. Kane and Kellyn S. Betts**

Robert W. Kane is a project leader in PC Labs. Kellyn S. Betts is an associate editor of PC Magazine.

PC MAGAZINE FACT FILE

Tatung 1595G
Tatung Co. of America Inc.
2850 El Presidio St.
Long Beach, CA 90810
(213) 979-7055
(800) 421-2929 (outside Calif.)
List Price: With DB-9 connector cable, $1,199. DB-15 connector cable, $25.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: The 1595G's slightly larger display area (15 inches) and almost-flat screen are overshadowed by its lackluster video performance. Its weaknesses could be overlooked if its price were lower.

CIRCLE 414 ON READER SERVICE CARD

switch) are thoughtfully placed along the lower front edge of the monitor. Curiously, the vertical and horizontal position controls have a center-detent position, but we found that these settings result in a hopelessly off-center image.

The 1595G is one of only a few models in this group with a text-mode switch that operates in analog mode, but its use is a mixed bag. It works quite well when set to display color images such as shades of green, but its amber position results in colors ranging from red to yellowish-green. It's probably best to forget that this latter position even exists.

In addition to its front-mounted controls, the 1595G has one feature that many users find highly desirable—an almost-flat screen. It isn't dead flat, as is the Zenith

The Tatung's almost-flat screen and front-mounted controls are highly desirable.

flat tension mask monitor, but it has decidedly less curvature than most. This, along with an etched screen, should eliminate glare in all but the worst lighting environments; it performed quite well on our glare tests.

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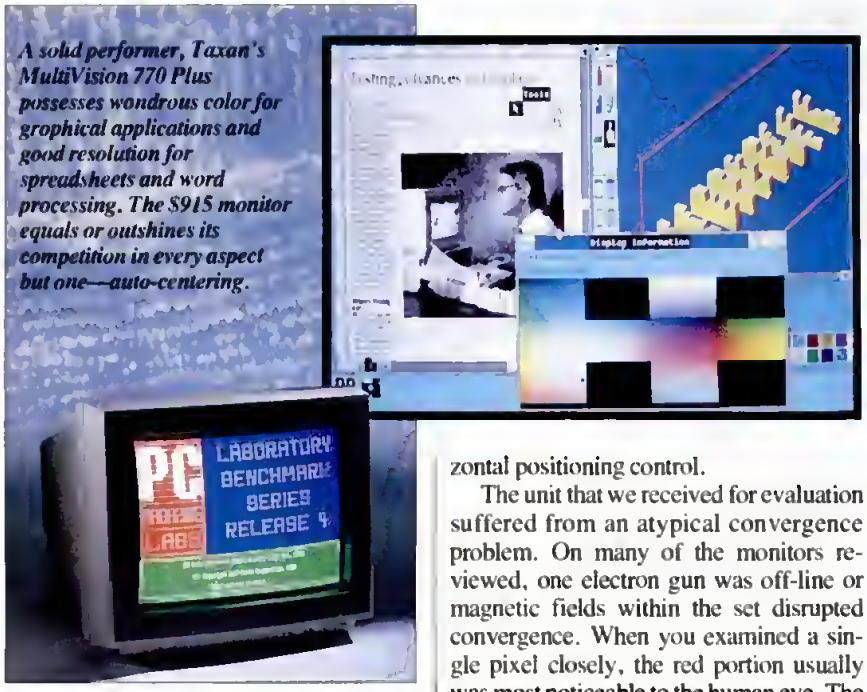
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CIRCLE 202 ON READER SERVICE CARD

Regardless of its strengths, however, the display quality of the Tatung 1595G makes it hard to recommend. At premium prices, one should expect top-shelf performance, and in this regard, the 1595G doesn't quite measure up.—**Frank Bican**



A solid performer, Taxan's MultiVision 770 Plus possesses wondrous color for grophical applications and good resolution for spreadsheets and word processing. The $915 monitor equals or outshines its competition in every aspect but one—auto-centering.

TAXAN USA CORP.

Taxan MultiVision 770 Plus

While it may not have the elasticity of an Olympic gymnast, Taxan USA Corp.'s MultiVision 770 Plus is a flexible and solid performer, possessing impressive color for graphical applications and good resolution for spreadsheets and word processing. At a reasonable $915, it equals or outshines its competition in every aspect but one: auto-centering.

The MultiVision produces impressive images, but you may have to do some initial labor to get them. When the Taxan MultiVision 770 Plus sent us was first turned on, it had sizing troubles. Attempts to adjust the vertical position caused resolution lines from the bottom of the image to break off and appear at the top of the screen. The screen image appeared flattened, too.

Luckily, Taxan offers incredible control and flexibility over the screen settings of its monitor. The monitor has 16 adjustable screws set into a rear panel; these screws control the action of knobs governing vertical size and vertical and horizontal position. Taxan even gives you a Phillips screwdriver to use with them. You must be willing to invest the time and effort necessary to learn to use the controls, but they're quite effective: after we toyed with them for a while, the monitor's image was greatly improved.

The MultiVision 770 Plus displays some of the most vivid colors of any monitor that we reviewed. This makes it an excellent choice for graphics applications. Its hues are bright enough to put it at the front of the pack, and its shading could rate a photo finish with the best of the monitors we reviewed.

Text is clearly legible, screen edges and vertical lines are ruler straight, diagonal lines are sharp, and right angles are indeed 90 degrees. Control of image brightness and contrast is excellent; turning up the brightness all the way causes only slight screen whitening.

This monitor sports a streamlined style that is pleasing to the eye. Nonetheless, its design could still use a bit of work: like just about every other monitor we tested, all of the MultiVision 770 Plus's image positioning controls are inconveniently located at the very bottom of the monitor back. This proves troublesome if adjustments to the screen become necessary. You may find yourself testing your own flexibility as you reach around the set to find the horizontal positioning control.

The unit that we received for evaluation suffered from an atypical convergence problem. On many of the monitors reviewed, one electron gun was off-line or magnetic fields within the set disrupted convergence. When you examined a single pixel closely, the red portion usually was most noticeable to the human eye. The green and blue portions, however, were clearly visible on the review unit from Taxan. Nonetheless, this did have a negligible effect on the monitor's performance. Text within *Microsoft Windows* at Super VGA level is a bit fuzzy, but the Taxan's resolution overall is still among the best in this roundup.

Another problem plaguing the MultiVision 770 Plus prevents it from getting an unconditional recommendation. In moving between applications, and especially into *Windows*, the screen image shifts off-center. In *Windows*'s 800 by 600 resolution, the screen image jumps to the right. New windows typically open off-center to the right, and the light blue *Windows* background goes from solid to alternating light and dark bands similar to those seen in wood grains.

The Taxan's solid performance in all other areas, in addition to its fine reputation, earn it a strong recommendation, with two strings attached. At a list price of $915 (the optional tilt/swivel base is $40 extra), it is overpriced, but you can find the MultiVision 770 Plus for much less. If you move from different applications frequently or work within *Windows*, you must test the unit before buying it, paying heed to the auto-centering capabilities.

—**Matt Ross**

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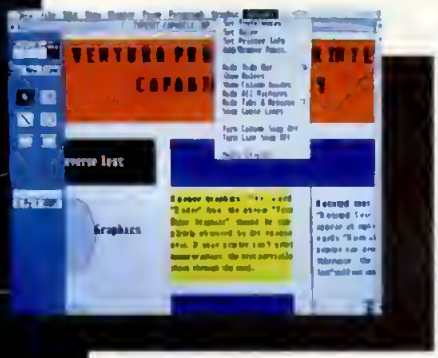
FACT FILE

Taxan MultiVision 770 Plus
Taxan USA Corp.
161 Nortech Pkwy.
San Jose, CA 95134
(408) 946-3400
List Price: $915. Optional tilt/swivel base, $40.
Requires: MDA, CGA, EGA, or VGA video card.
In Short: With the best color performance of the monitors reviewed, the MultiVision 770 Plus is an attractive monitor, though it suffers from image centering problems.

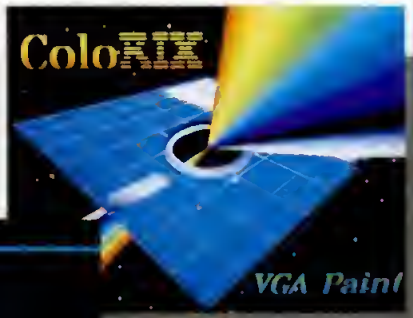
CIRCLE 415 ON READER SERVICE CARD



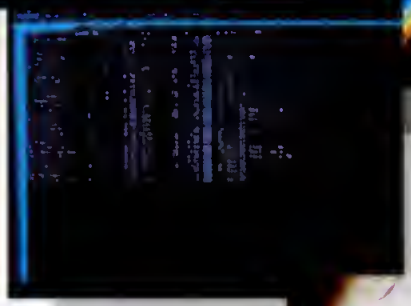
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CIRCLE 741 ON READER SERVICE CARD

3LYNX TECHNOLOGIES CORP.

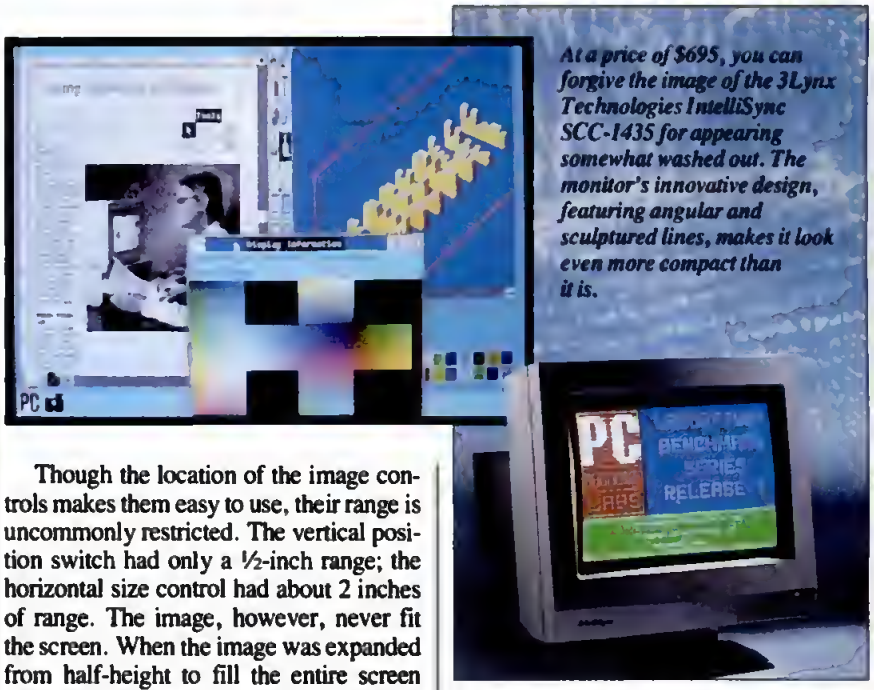
IntelliSync SCC-1435

Its image appears washed out compared with a NEC MultiSync II display, but the IntelliSync SCC-1435's $695 price, nearly half that of NEC's latest, the MultiSync Plus, helps make up for that lack.

The SCC-1435, from 3Lynx Technologies Corp., is notable for its innovative design. Instead of the bulky, orange-crate look of so many high-performance color displays, the IntelliSync has an angular and sculptured designed. Its shape makes the modest 13⅜- by 13½- by 15-inch (HWD) box appear even more compact on the IntelliSync's built-in tilt/swivel stand, notwithstanding its standard 14-inch display tube.

The rear of the IntelliSync is finished in a medium gray-beige, while the 6-inch-deep band behind the screen and the bezel masking the 10½- by 7¾-inch viewing area (12⅞ inches diagonally) is finished in white-beige.

In keeping with its fresh styling, the primary user controls of the IntelliSync—brightness and contrast—are linear slides near the lower-right-hand corner of the screen. While attractive, the short stroke of these controls makes them a little trickier to adjust than the typical rotary controls. Most of the IntelliSync's other user controls are small shafts concealed behind a door under the lower edge of the front panel bezel. These include horizontal and vertical size and position, and a color/mono/inverse video slide switch.



At a price of $695, you can forgive the image of the 3Lynx Technologies IntelliSync SCC-1435 for appearing somewhat washed out. The monitor's innovative design, featuring angular and sculptured lines, makes it look even more compact than it is.

Though the location of the image controls makes them easy to use, their range is uncommonly restricted. The vertical position switch had only a ½-inch range; the horizontal size control had about 2 inches of range. The image, however, never fit the screen. When the image was expanded from half-height to fill the entire screen vertically, its sides were cut off ¼ inch at the right screen edge and ⅛ inch at the left, when adjusting with the horizontal position control.

It's a good thing the image controls are handy, for the IntelliSync's autosizing capabilities are not able to fully compensate for all video standards. When VGA images are set for an eye-pleasing 7⅜-inch height, EGA images measure a squat 6¼ inches and 800 by 600 images grow to 7⅝ inches. When changing modes, the IntelliSync monitor also demonstrates a slight image bounce that settles down after a second or so.

The IntelliSync produces pleasing—if somewhat washed out—images across its dark-faced, .31mm shadow mask display tube. All colors are bright, and all—including brown—match the IBM palette well. Image geometry is very good and convergence acceptable, with blue about .5mm. low in the lower right and red about .3mm low in the lower left. Although 3Lynx claims that the screen has been etched to eliminate glare, the treatment wasn't as successful as those used by some of the other multiscanning displays we evaluated, and the monitor didn't do particularly well on our glare tests.

According to 3Lynx, despite the monitor's modest 30-MHz bandwidth, the IntelliSync will display noninterlaced images with resolution up to 940 by 600 pixels or up to 1,200 lines of vertical resolution when interlaced. The monitor has earned an FCC Class B certification. It comes with an adapter cable for VGA signals; both ends of the cable near the connectors are wrapped with large, unencapsulated ferrite slugs to minimize interference from radiation. Because ferrite is a brittle ceramic, these slugs may be subject to shattering should the cable be dropped onto a hard surface (such as a concrete floor).

The IntelliSync's colors are bright, and all match the IBM color palette.

Compared with other multiscanning displays, the IntelliSync falls into the vast middle ground. Its chief distinctions are its innovative styling and its low price.
—Winn L. Rosch

FACT FILE

IntelliSync SCC-1435
3Lynx Technologies Corp.
1450 Seareel Lane
San Jose, CA 95131
(408) 432-8833
(800) 24-3LYNX
List Price: With both DB-9 and DB-15 connector cables included, $695.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: An innovatively styled monitor, this 14-inch Taiwan-made display's image is a bit washed out.

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PC MAGAZINE

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BY EDWARD MENDELSON

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■ MULTISCANNING MONITORS

TW CASPER CORP.
TM-5155H

A popular pick to pack with PC systems from smaller vendors because of its relatively modest $658 list price, the TM-5155H from TW Casper Corp. is an otherwise unremarkable monitor. The Taiwanese set falls closer to the bottom than the top of this line-up of multiscanning monitors, because its images show more defects than most.

One of the TM-5155H's major failings is its lack of autosizing abilities, a problem that is exacerbated by the limited range of its horizontal-size switch. The best image with proper aspect ratio that could be made on the TM-5155H in VGA text mode measured 9½ by 7⅛ inches (11¾ inches diagonally).

Switching VGA modes with the controls set for this image caused size to vary widely, from 6¼ inches high in EGA-compatible 350-line mode to beyond screen height in 480-line or 600-line graphical modes. When the horizontal-position control was adjusted, the image folded over ½ inch inside the left bezel edge, cutting off 3/16 inch inside the right. The size of the image swelled perceptibly as brightness was increased.

The TM-5115H's display shows other image deficiencies, including noticeable barrel distortion and separation of the top scan line from the top of the image, an effect that is particularly visible in white-on-blue text mode.

Convergence was tolerable, with the red gun about .5mm high on the top-left screen corner according to our manual measurements.

Because of their deficiencies, the images produced by the TM-5155H often require adjusting. Unfortunately, the monitor's controls are not conveniently located—unless you like standing up and leaning over your monitor. Most of the controls are relegated to a panel hidden behind a door atop the display. Feeling for the correct shaft is sure to create on-screen chaos, since the panel contains the knobs for brightness, contrast, vertical size and position, horizontal size and position, and vertical-hold knobs. Strangely, the only front-panel control on the TM-5155H is a

FACT FILE

Casper TM-5155H
TW Casper Corp.
2153 O'Toole Ave., Suite E
San Jose, CA 95131
(408) 922-0188
List Price: With DB-9 connector cable. $658. DB-15 adapter available; price varies according to dealer.
Requires: MDA, Hercules, CGA, EGA, PGC, VGA, or Super VGA video adapter.
In Short: Its price makes it enticing, but this Taiwan-made, 14-inch display shows more image defects than most.

CIRCLE **397** ON READER SERVICE CARD



Favored with a relatively modest $658 list price, the TM-5155H from TW Casper Corp. tested nearer to the bottom of this line-up because of its lack of autosizing.

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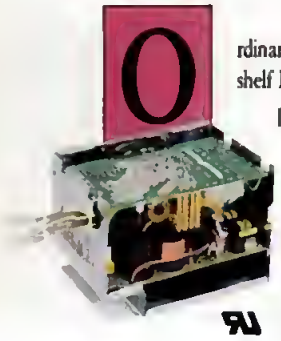
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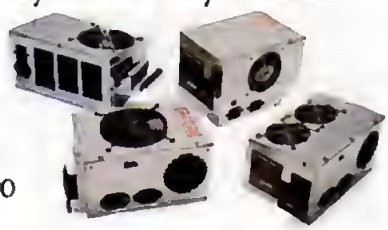
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CIRCLE 473 ON READER SERVICE CARD

PC MAGAZINE EDITOR'S CHOICE

- **NEC MultiSync Plus**
- **Taxan MultiVision 770 Plus**

The emerging extended VGA video standard, also known as Super VGA or VGA Plus, offers the best combination of performance, resolution, and bang for the buck. The best of these 12- to 14-inch multiscanning color monitors represent no-lose propositions: they offer compatibility with today's 800 by 600 extended VGA factions and tomorrow's likely 800 by 600 Super VGA standard, fallback compatibility with IBM's original 640 by 480 VGA standard, the ability to work with existing EGA video cards, and compatibility with Apple's 640 by 480 Macintosh output.

NEC was first with a multiscanning monitor back in 1985, anticipating VGA by a year and a half. NEC's latest offering, the MultiSync Plus, is clearly at the head of the class. The only monitor in this batch capable of displaying a VGA superset 1,024 by 768 image without resorting to the interlacing that mars IBM's 8514 video system, the MultiSync Plus is graced with decent color and crisp, distortion-free images. As well it should be for $1,399.

What about NEC's more affordable MultiSync II ($949 list)? Alas, it's out of production, replaced by the more expensive MultiSync 3D ($1,149, received too late for review) and the cheaper, analog-only MultiSync 2A ($799).

The Taxan MultiVision 770 Plus proves its worth by its bright, accurate VGA and Super VGA colors and sharp, clearly legible text. At $915 list, it's markedly more affordable.

Honorable mention goes to Samsung's $699 Sync Master CN4551. While the Samsung does not possess all of the qualities necessary to rate as an editor's choice, its image quality is nonetheless good, and the monitor autosizes with aplomb.

Note: If the crispest, most glare-free image is what you're after, you'll have to forgo all these Super VGA monitors for the fixed-frequency Zenith 1490, whose flat tension mask construction won PC Magazine*'s 1987 Award for Technical Excellence. If you can live with 640 by 480 resolution, you can't beat the image quality.*

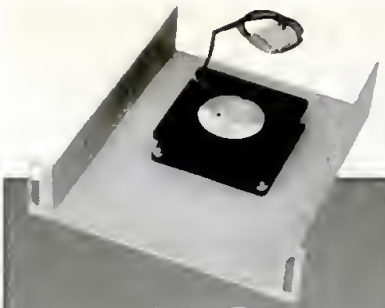
rectangular push button that selects text color.

The basic endowments of the TM-5155H conform to the mainstream of multiscanning monitors. Though it has only a 30-MHz bandwidth, this monitor is able to exceed its maximum rated resolution, 800 by 560 pixels, by displaying 800- by 600-pixel images. Compared to an IBM VGA display, the 14- by 14¼- by 15-inch (HWD) TM-5155H looks bulky, with a wider cross-section to its white-beige plastic case. However, a full 13-inch diagonal can be measured through its dark gray-beige screen bezel. The face of the .31mm dot pitch, shadow mask tube is medium to dark gray and has been lightly antiglare treated. It bears an FCC Class B certification. Casper supplies a 43-inch video cable that terminates with 9-pin connectors at either end. A 9- to 15-pin cable for VGA connections is optional.

If your demands are minimal, the TM-5155H will satisfy them. It is not a display for critical applications—unless your budget is in critical condition.

—Winn L. Rosch PC

Frank Bican and Winn L. Rosch are contributing editors of PC Magazine. *Matt Ross is an editorial assistant at* PC Magazine.



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- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit & 2 32Bit)
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Options:

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- Custom configurations w/Name Brand peripherals of your choice
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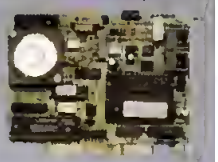


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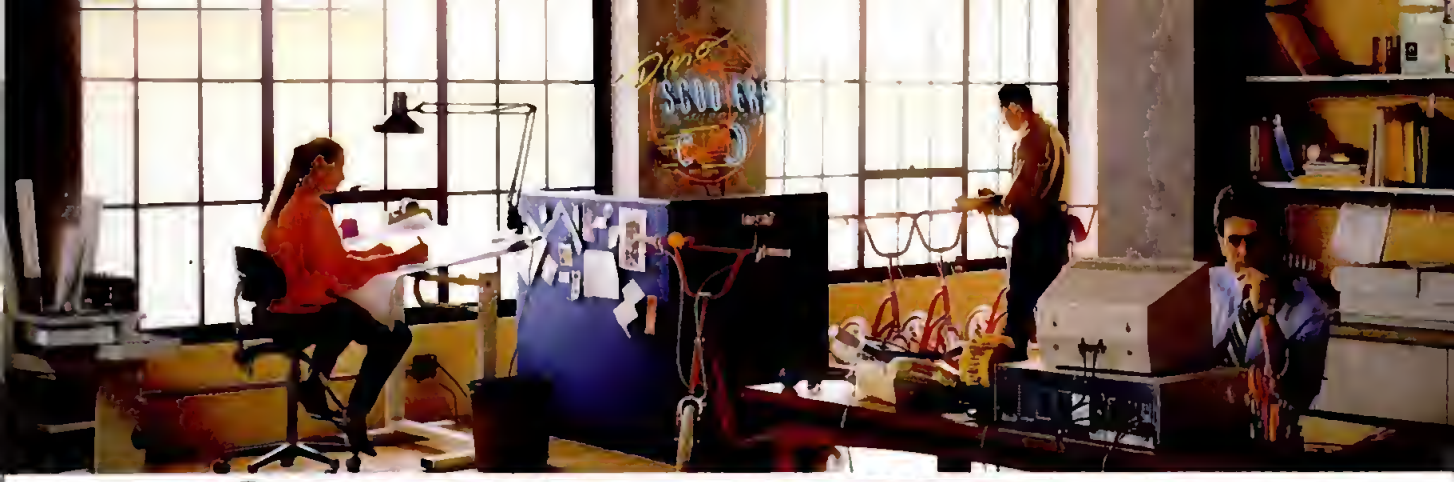
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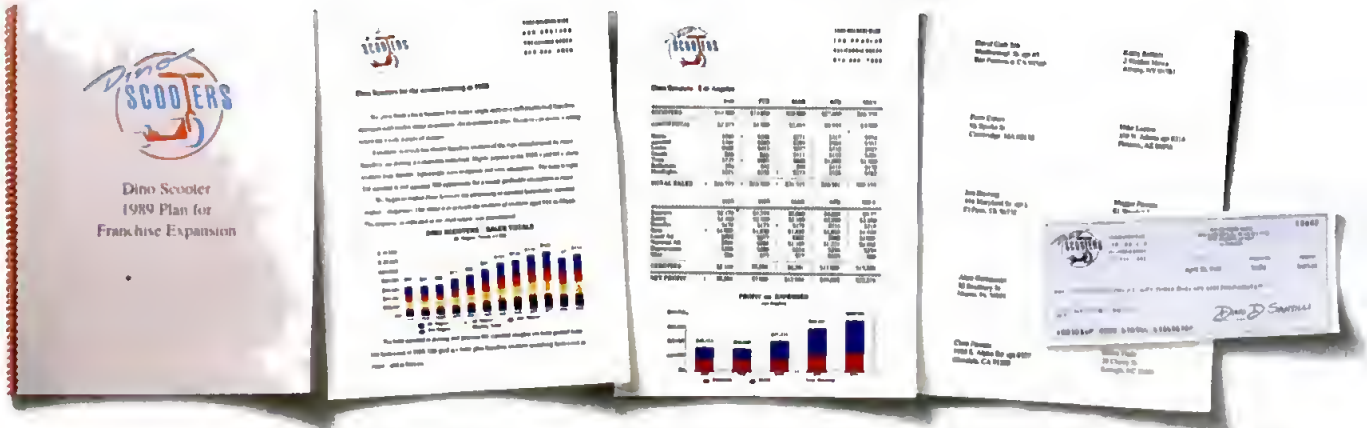
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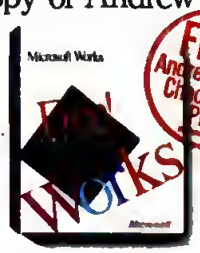
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Is the daunting process of large-scale project management getting any easier? Evaluations of Open Plan, Plantrac, Primavera Project Planner, Qwiknet Professional, SSP's Promis, and ViewPoint yield some answers.



ONE PROJECT, 3,000 TASKS

HIGH-END PROJECT MANAGERS MAKE THE PLANS

Any large project is demanding on many levels. It can involve scheduling thousands of tasks and hundreds of resources in an intricate weave of dependencies and availabilities. Any number of aspects must be tracked accurately to control costs and keep the goals in sight. Top management people want summarized status reports in the best presentation-quality style; line managers need to see the nitty-gritty details of individual activities. And a project doesn't occur in isolation: it has to fit within the context of other ongoing projects.

Such intense yet varied demands require ultrapowerful project management software. Though popular sub-$500 programs like Symantec's *Time Line* and Computer Associates International's *SuperProject Plus* get stronger every day, and the distinctions between them and the heavy hitters are blurring, gigantic projects remain within the realm of high-end packages that cost upwards of $2,000. The programs we review here are the most popular in this category. They generally meet the demands of large projects with aplomb. Each has a distinctive personality, emphasizing different aspects of project management.

To explore their features we used a large corporate relocation project, designed for us by Daniel Yahdav, president of I Soft Decision In

Illustration: Masato Nakamura

San Rafael, California. Yahdav, a project management consultant, publishes an extremely detailed quarterly analysis of commercially available project management packages. Our project uses summary tasks, subprojects, and a mix of dependency types; it has labor, materials, and fixed-cost resources, and takes a little over 8 months to complete.

PERSONALITIES The way a program looks and feels may seem to have little to do with how well it can handle the demands of large projects. In fact, it can be crucial. If a program is obdurate or rigid, it won't cope with unusual circumstances, and most large projects have something unique about them. If a program is aloof or difficult, it won't suit the needs of people with different levels of planning expertise. If a program is overly complex, some project elements will be ignored.

High-end project management programs have had a reputation for poor personality traits. Although there have been improvements, even the best programs suffer to some degree. For example, a number of programs force you through a whole series of menus and setup screens before you get anywhere near the actual planning functions. Take *SSP's Promis*. Its first screen requires the correct user name and a password. If you pass this barrier successfully, you have to go through nine more screens or parts of screens before you can enter activity details—and that's on a project that already exists.

Other programs reveal their difficult side when you get to know them better. For example, in *Qwiknet Professional*, examining resource cost and usage requires going through a Cost Display window, where you indicate how 12 equations should be applied; then you go to a Cost Records and Summarization window to choose the record sets to work with and a summarization method. Not exactly the friendliest approach.

Open Plan hides its difficulty until you want to use advanced features. The program comes with a bevy of preformatted reports. If you want to create your own, however, you have to use a report writer that takes 182 pages in the manual to describe. Custom reports can include both *dBASE III* code and code specific to the report writer. The miniprogram for a simple bar-chart report would be 26 lines long and would include statements like this: "PRINt "Report:",%REPNAME AT +0, "BARCHART" AT 40 CENTer,". The position of each character and the correct use of upper- and lowercase letters are imperative.

A couple of programs have added a graphical interface to improve their personalities. *Plantrac* and *Open Plan* both offer the ability to build a project network diagram interactively, bypassing their standard menu- and form-driven approach. While in both cases the interface works well and looks nice, it feels put on. The rest of the program—the method for setting up resource availabilities, the time and resource analyses, the reporting—is so different stylistically that the graphic interfaces seem like another program.

■ If there is one characteristic that sets high-end programs off from midrange and low-end programs, it's their scheduling capacity.

Only one program has a graphic interface that encompasses all its features: *ViewPoint*. It uses a time-scaled network diagram as the central arena for building a project; this gives users an almost physical sense of the project. It's also faster. Even resource constraining is graphic. To set automatic limits, users draw a constraint line of varying height across a resource histogram.

Windowing is another personality enhancer. *Qwiknet Professional* uses windows to tremendous advantage, letting you move and resize literally every form, screen, or menu in the program. You have the ability to open 80 windows at once if you want to. Other project management programs use windows to some extent. *Primavera Project Planner*, for example, has nine window options on the Activity data screen, including budget, financial, predecessors, and resources.

SCHEDULING CAPACITY If there is one characteristic that clearly sets the high-end programs off from midrange and low-end programs—and perhaps justifies the cost—it's their scheduling capacity. These programs can handle projects with more than a thousand activities. *ViewPoint* can go as high as 65,000, giving it the largest capacity; *SSP's Promis* is at the opposite end of the spectrum, with a limit of 2,000. Large projects average about 2,000 or 3,000 activities, but some can have 10,000 or more.

With so many activities in a project, it becomes essential to group them into logical categories. Then, through sorting and selecting, you can examine and report on the portions of the project that will be most important to you at a given time. Work breakdown structure (WBS) and organizational breakdown structure (OBS) are two of the well-established methods for grouping activities.

WBS puts activities into a hierarchy of work phases. It's a way of looking at tasks and projected accomplishments in increasing order of detail—from the broadest down to the most atomistic. Between these extremes are intermediate work phases, which may have a dozen or more activities subsumed under them. OBS codifies activities by area, department, and responsibility. Activities may be tagged in other ways as well—by location, outside contractor, type of work, and so on.

High-end project managers use the activity ID and code fields to give a project these structural markers. Often an ID field or a code field can be broken down into subcodes. For example, in *ViewPoint* there is a 16-character activity code that can be broken down into as many as 11 different codes. In *Open Plan*, activity codes can be split into seven levels; each can be described, and the code field can be labeled for WBS or OBS. Two is the minimum number of code fields—in addition to the activity ID—in any of the programs we reviewed. *Primavera Project Planner* takes coding the most seriously. It offers 20 activity codes, plus four ID codes. Each can be named and described.

RESOURCE MANAGEMENT Another aspect of scheduling involves resource availability, allocation, and leveling. To help you use resources well, a number of programs allow you to enter availability dates, resource amounts, and cost factors. For example, in *Qwiknet Professional* you can record six availability dates and resource amounts in the Add Resource window. You can't change the way resources are charged to activities. In *Plantrac* you can have as many entries of a resource as you want, changing its dates, usage schedule, and available quantity each time.

All the high-end programs do two kinds of resource leveling. The first kind is called *time-constrained* leveling. This means the program will monitor projected schedules and critical-path dates to make sure that resources are available when they're needed. Often this kind of resource leveling isn't sufficient to solve availability problems. The second form of leveling, called *resource-constrained* leveling, pushes activity dates to wait for resources to become available. This often means extending a project past its original end date.

There is considerable variance among high-end programs in terms of the number of distinct resources a project and activity can be assigned—and how many resources can be monitored at once. For example, *ViewPoint* lets you have 65,000 resources in a project, and all 65,000 can be assigned to one activity (even though you would never do this). *Plantrac* lets you have only 200 total resources, up to five per activity. *Primavera* and *Promis* have no theoretical resource limits. When it comes to resource leveling, however, *Promis* will level only five resources at a time, and *Primavera* won't let you level more than 40 resources altogether.

Almost all the high-end project managers have one scheduling flaw in common: they won't schedule activities in all possible time intervals. At present, only *Plantrac* will schedule in years, months, weeks, days, hours, and minutes. *Primavera* and *Promis* schedule only in days. In the next versions of these programs, however, this will change. *Promis* will schedule down to the minute and up to the month; *Primavera* will add on weeks and months.

Careful tracking of a large project is essential because a schedule can easily be thrown off when thousands of activities are involved. Tracking really consists of two processes: entering progress and reporting. Most of the high-end programs do a good job at both. Often progress in time, cost, and work can be tracked separately to reflect exactly what is happening in the project.

■ In the high-end programs, reporting is generally outstanding. These packages offer standard reports that you can customize.

REPORTING In the high-end programs, reporting is generally outstanding. These packages offer a great many standard reports and allow you to customize them through sorting and selecting, as well as by using some limited formatting options. *Open Plan* may hold the record when it comes to reporting. It offers almost 60 standard reports, and through its report writer you can potentially create any report you can imagine. Learning to use the report writer takes dedication, however. This is true of other project-management report writers, because they are really little programming languages.

Graphs are a most important part of reporting. Gantt charts, time-scaled network diagrams, precedence and arrow diagrams, and other traditional project management graphics are the best ways to make the project status comprehensible. High-end packages excel at these reports but may require an add-on graphics program to produce them. With the graphics in place, the programs support a wide range of plotters. Some of the programs will let you merge two graph types on one plot.

In the future, as more corporations move to LANs and a workgroup style of computing, high-end project-management programs will need new features. For example, notification of schedule slippage might become automatic across an electronic mail system. There might also be a company-wide resource library rather than individual project resource libraries. Creative what-if features for executive decision support may become commonplace.

Whatever new features may appear, you can be sure the high-end programs will evolve into increasingly powerful, flexible systems. Large projects demand nothing less.

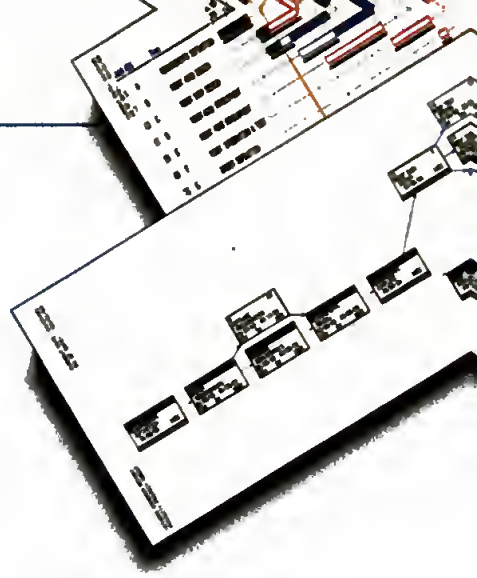
Open Plan

Welcom Software Technology Corp.'s *Open Plan* is like a big ice cream sundae: every conceivable flavor is thrown in, and somehow the tastes all work together. There are function-key menus, pop-up windows, speed keys, a graphical interface within a spreadsheet framework, scroll bars, mouse support, slash-key menus, and the *dBASE* command language. With this concoction of operational tools, *Open Plan* delivers an amazing assortment of project management features. Because the program uses *dBASE*, you can modify the structure, menus, and functions to make the program do almost anything you want.

The price you pay for all this power is the time and effort required to learn the program—plus $4,200, which makes it more expensive than any other high-end package we reviewed in this article.

To begin with, you need to have *dBASE III Plus* or *FoxBASE Plus* to use *Open Plan*. All the project data is kept in files within one of these two database programs. You don't have to know anything about them to do basic project scheduling and tracking, but if you want to customize *Open Plan* and stretch its capabilities, you had better be comfortable working with the database program. There are only two activity-code fields and no priority field in the *Open Plan* that comes out of the box, but you can add codes and priority numbers by using the database language to redesign the activity screen. Customized screens and menus can be saved and used for other projects as well.

Open Plan has a standard function-key



Project Scheduler 4™

The difference is graphically clear.™

Project Scheduler 4 set new industry standards for power, speed, and ease of use. Now Version 1.5 raises PC-based project management to an even higher level. In business after business, people are making the change to Project Scheduler 4. Why? The following comparisons make the reasons graphically clear.

Features	Project Scheduler 4	Time Line 3.0™
Gantt chart mode	•	•
Network chart mode	•	•
Spreadsheet mode	•	
Selectable Gantt graphics	•	
Fine grain summary Gantt charts	•	
Network chart automatic task placement	•	•
Multiple auto network draw algorithms	•	
Network chart interactive task placement	•	
Resource allocation & costing	•	•
Resource automatic time based cost inflation	•	
Resource calendars	•	
Automatic resource leveling	•	•
Interactive resource leveling	•	
Multiple project structures	•	
PERT schedule probability analysis	•	
Schedule & cost tracking	•	•
Independent multi-project support	•	
Integrated printer & plotter graphics	•	
Postscript graphics support	•	
Full data export	•	•
Full data import	•	

Benchmark All times in seconds	Product	Number of tasks 100	200	300	400	500
Schedule Recalculation	Project Scheduler 4	0.8	0.9	1.0	1.1	1.2
	Time Line 3.0	10.3	22.6	372.4	1024.8	1283.6
Display Network Chart	Project Scheduler 4	1.0	1.1	1.2	1.4	1.5
	Time Line 3.0	134.5	*	*	*	*
Load Project File	Project Scheduler 4	2.7	3.8	5.7	7.7	13.5
	Time Line 3.0	18.4	32.4	84.2	180.9	244.5
Save Project File	Project Scheduler 4	3.1	4.5	5.4	6.4	8.1
	Time Line 3.0	18.1	35.8	75.0	102.4	128.0

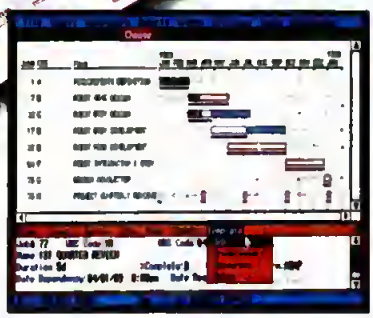
*After computing for over 12 minutes, Time Line displayed an "Unable to display Network View" message. All benchmarks were run on a 12 MHz 286 with 640k RAM.

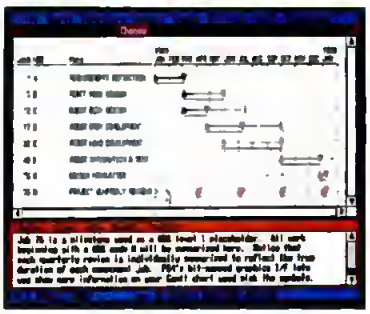
Unmatched power at your fingertips.

Project Scheduler 4 offers an impressive list of industry-leading power features. Projects are planned and tracked in a full graphics environment. You understand more because you see more on the screen. At last, PERT and Gantt charts make sense. Responsibilities, deadlines, and resource bottlenecks are spotted at a glance. You see more on paper, too. Beautiful, graphic reports print sideways, so you never have to cut and paste. They're instantly understandable. Not to mention simple to generate for impressive presentations.

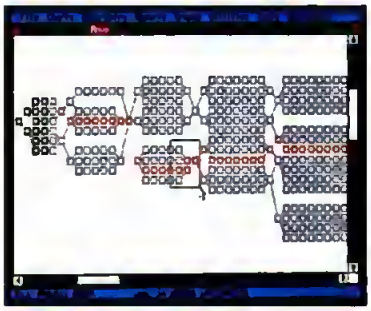
Time-saving, world-class speed.

In benchmark tests, Project Scheduler 4 consistently outperforms all the competition as the fastest full-featured product in the industry—by a very wide margin. After all, what good are power features without the speed to make them useable. And the bigger your project, the more speed counts. Even at the 1000-task level, Project Scheduler 4 takes only 1.5 seconds to perform schedule recalculation. When your time is on the line, your project scheduler should help you manage it, not waste it.



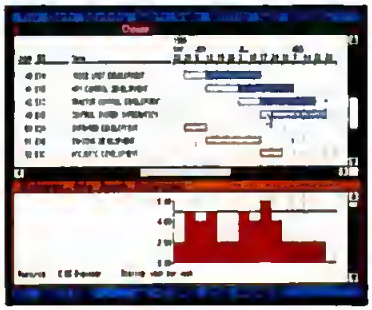


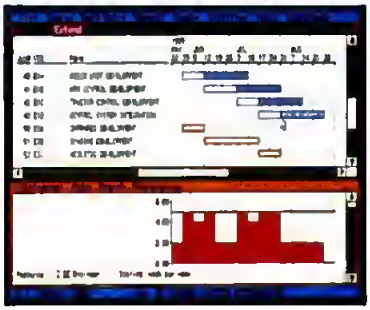
Project Scheduler 4 lets you view a Gantt chart in one window, while you enter or edit in another. Complete status information gives you a clear, precise overview of your entire project. You control exactly what time scale is displayed on the screen: minutes, hours, days, weeks, months, or years. Display preferences include alternate Gantt chart symbols, free and total float, baseline, WBS and OBS filters, and much more.





Four reduced network zoom levels let you view more or less detail, depending on what you need to see. Each level provides drawing tools for positioning tasks in the network and changing predecessor relationships. When working with PERT probability analysis, Project Scheduler 4 lets you control probability weights and specify alternative task duration times, while the program instantly recalculates the critical path.





In Gantt Histogram mode, a single mouse click quickly finds resource overloads and displays a list of problem tasks. To see the planned resource utilization for a task, point at it in the Gantt chart, and the corresponding area in the histogram is automatically shaded. Project Scheduler 4 lets you level resources interactively using Gantt chart Extend or Delay mode. In the example on the right, Extend mode is used to expand the duration of a task that shows free float—eliminating resource overload with a single click of the mouse.

Function	Project Scheduler 4	Time Line 3.0
Advanced graphical user interface	•	
On-line help	•	•
Step-by-step assist mode	•	
Full mouse support	•	

Time Line 3 0 is a registered trademark of Symantec Corp.

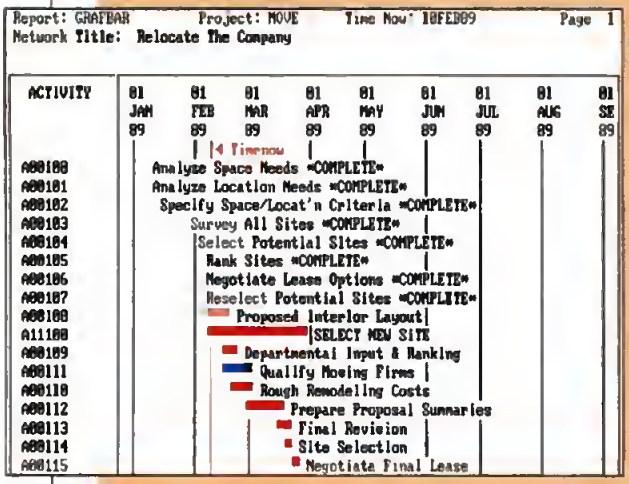
Exceptional ease and elegance.

Project Scheduler 4 offers sophistication that's simple to use. Its intuitive, graphic interface gives you a clear overview of the entire scheduling process—with no hard-to-remember commands or keystroke sequences. Ideal for both beginners and experts, Project Scheduler 4 is the future of advanced productivity tools.

Only Project Scheduler 4 offers the advanced graphics, high-speed performance, and ease of use you need to save time—and maximize productivity. For more information and a brochure, call or write:

415/570-7700
250 Lincoln Centre Drive
Foster City, CA 94404

Scitor Corporation



This Gantt chart in Open Plan *shows a project already in progress. The completed activities have no bars. Instead, you see their description followed by the word* Complete. *Activity A00108, Proposed Interior Layout, is partly finished, so the first part of its bar is green. Activity A00111, Qualify Moving Firms, is noncritical, so it is in blue with a black section representing float.*

menu interface, and a graphical interface under the heading of Project Worksheet. The function-key menus are straightforward, and context-sensitive help is always available in pink pop-up windows. Activity, resource, code, and calendar data are kept segregated from project files so that they can be linked to multiple projects. As a result of their independence, however, you have to reselect the project you're working on every time you perform a new function.

One of the nicer aspects of the standard interface is the Activity Maintenance screen. It's composed of a box with activity data fields and a switchable side panel for fields relating to resource allocation and activity dependencies. The basic activity data includes a calendar number (you can create 256 calendars), two code fields (used for work breakdown and organizational breakdown structure), and a budgeted cost. The side panels are changed with function-key commands listed at the bottom of the screen. When you're entering resources or dependencies, you can call up a window of available choices and copy a selection over to the data field.

Other function-key commands on the activity screen let you jump to a progress form or browse through a table of activity information. As you browse you can also update records. Being able to see 11 activities at once and to scroll continuously or page down through the rest lets you quickly get an activity overview. A search function, found among the slash-key commands on the activity screen, lets you find any activity instantly by entering its ID. A Func Keys command lets you assign a string of text to each of the keys from F2 through F9, so you can enter frequently used codes with a tap of your finger.

PROJECT WORKSHEET The other method of working on a schedule, Project Worksheet, lets you interactively build a network diagram of activities. You're presented with a blank screen bordered by row and column designations to indicate cells, just like a spreadsheet. The cursor is represented by four flashing corners and is moved around using the arrow keys or a mouse. The right-side border and the bottom border are scroll bars for the mouse. Above the top border is a command bar with pull-down menus.

When you've decided on the placement of an activity, you call up the same box of fields that appears on the Activity Maintenance screen. The activity's initial dependency (its time-based relationship to the activities around it) is established by marking the activity boxes with the cursor. Further dependencies and resource data are entered separately in pop-up boxes at the bottom of the screen. When you move the cursor onto an activity box, detailed information pops up onto the screen. The network diagrams you create come in either precedence (PERT chart) or activity-on-arrow styles.

The Project Worksheet approach makes it very easy to see the logical relationships among activities. The resulting networks are quite attractive. You have complete control over the column widths and colors. However, the networks don't show the time-related aspects of a project, and you can't call up a Gantt chart within this interface.

Open Plan is set up to schedule activities in days or to do microscheduling in minutes or hours. You can get weekly scheduling, but you have to trick the system by defining a calendar with only one working day in a week. If you're doing microscheduling you split the day into even intervals measured in hours or minutes—say, 6 hours or 15 minutes. Microschedule calendars can define up to three start/stop times for every day of the week. The program was among the three fastest at both scheduling and resource leveling; of the six products reviewed, only *ViewPoint* was consistently faster.

After activities have been entered and the schedule processed, it's time to work on resources. Resource availabilities are recorded with a code, description, unit

EDITOR'S CHOICE

PC MAGAZINE FACT FILE



Open Plan
Welcom Software Technology Corp.
15995 North Barkers Landing, #275
Houston, TX 77079
(713) 558-0514
List Price: $4,200

Requires: 640K RAM, hard disk, DOS 2.0 or later with *dBASE III Plus* or later or *FoxBASE Plus* 2.1 or later.

In Short: If *Open Plan* is the most richly featured project management program, it's also the most costly. Because the program needs either *dBASE III Plus* or *FoxBASE* to run, it is even more complex and difficult than its own features would dictate, unless you're a *dBASE* aficionado. *Open Plan*'s reports and graphics are particularly good. Not copy protected.

CIRCLE 402 ON READER SERVICE CARD

designation (such as man-hours or tons), and unit cost. Consumable resources are indicated in a special "type" field. Each resource also has an availability amount indicated for at least one date range. One sign of *Open Plan*'s depth and precision is that you can assign an unlimited number of availability amounts and date ranges to a resource, each with a calendar. You can also enter a resource threshold number; this is the number of additional resource units you can call on to avoid project delays when you do resource-limited scheduling.

■ *Open Plan*'s reporting features are wonderful. There are close to 60 standard reports in the program.

Resources are assigned to activities back at the Activity Maintenance screen. In the side panel you enter the resource code, the number of units needed, and how the resource is to be applied to the activity—spread evenly over the duration or used at certain time intervals. You also indicate when the resource is first needed and how long thereafter. You can specify any number of usage parameters for a resource by reassigning it repeatedly, thus building up a very complex resource-allocation profile.

SCHEDULING OPTIONS *Open Plan* offers both resource-leveled (time-limited) and resource-limited scheduling. In resource-limited scheduling, if available float (margin of error) and thresholds (limits) are breached the program will change the end dates of critical activities—and of the project as a whole. You can mark six fields that control how priority conflicts are resolved. Three of these fields are used in time-limited scheduling, the other three in resource-limited scheduling. If activities are delayed, the resource code for the offending resource is included in the activity record and is available for reporting.

Once a project has started, you keep track of it by entering progress information and generating reports. Progress is entered by percent complete, elapsed duration, or remaining duration. You can also enter actual start and finish dates. Cost progress is maintained in two fields: physical percent complete and actual cost to date.

In addition to the progress data, cost tracking is heavily dependent on work breakdown and organizational breakdown codes, and on the budgeted cost figure entered on the activity screen. Cost control is basically a reporting function. This makes *Open Plan* one of the best programs at handling cost control, because it has an extensive set of reports—including those required for government projects using C/SCSC guidelines. And this is only the beginning. Using *dBASE*, you can create new cost fields, such as overhead costs and cost types and design new reports.

Open Plan's reporting features are wonderful. There are close to 60 standard reports in the program. The graphic reports are well designed on-screen and excellent as plotted output. The sorting and selecting capabilities are almost unlimited because of *dBASE*. And *Open Plan* includes its own command-driven report writer.

Open Plan includes a host of other features and abilities. What makes this program so powerful is the incredible amount of customizing you can do. Unfortunately, this power makes the package difficult to learn and use for anything beyond the basics. Although the basics may be sufficient for most users, at $4,200 the cost is anything but basic. In fact, *Open Plan* tops the cost chart for the products we reviewed, even before you consider the requisite purchase of *dBASE III Plus* or *FoxBASE*. If you already use one of these programs, however, *Open Plan* would be a good sophisticated choice.

Plantrac

Computerline's *Plantrac* is a program of many faces. It has beginner, intermediate, and expert modes, plus a separate but linked graphical interface. Your projects can be constructed in the precedence or arrow network method, or you can use a bar chart. You enter activities on a screen that can be laid out to indicate dependencies, resource assignments, costs, codes, and progress—or any combination of them. The flexibility of the interface makes it easy for a person with almost any kind of project-management experience and style to find a way into the program. Pass beyond the basics and the program can be hard to learn and use, but *Plantrac*'s balanced and flexible set of scheduling, resource, and cost features make the effort pay off.

Your first choice in *Plantrac* is the operating mode: beginner, intermediate, or expert. If you choose expert, the main menu screen has 39 selections on four lists; their abundance is overwhelming and somewhat intimidating. Clearly, this is the reason Computerline introduced the intermediate and beginner modes. Beginner mode has the same four menu headings—Subprojects, Resource, Cost, and Other—but only the first menu has selections on it, and there are only five of them. Some of the beginner choices on this menu are different from the expert choices, to make basic planning more accessible. The other difference in beginner mode is the explanation box in the middle of the screen, which changes as you highlight choices. Even when you go down to second-level menus you get explanation box-

PC MAGAZINE FACT FILE



Plantrac
Computerline Inc.
P.O. Box 308
52 School St.
Pembroke, MA 02359
(617) 294-1111
List Price: $3,000
Requires: 256K RAM, hard disk, DOS 3.0 or later.
In Short: *Plantrac* is a very well-balanced program with good scheduling, resource, and cost features. One of its distinguishing characteristics is its three operating modes: beginner, intermediate, and expert levels. The main avenue to program functions is through pull-down menus, but *Plantrac* offers a graphical approach to creating network diagrams, too. Not copy protected.

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es. Although the beginner mode has a simplified face, it allows you to get at all of *Plantrac*'s features.

The intermediate mode really isn't a separate mode at all. The mode simply limits you to the first 17-item expert menu when you begin.

TWO BASIC INTERFACES In all three modes there are two basic interfaces for building a project: graphical (Easyplan) and comprehensive. Easyplan gives you a drawing window with a fill-in box on the side and function-key commands at the bottom. You start by positioning the cursor and pressing F1 to Make an activity entry. A small box with an activity number appears in the window.

■ In all three of *Plantrac*'s modes, there are two basic interfaces for building a project: the graphical (Easyplan) and the Comprehensive Input interface.

After entering other basic activity data in the fill-in form, you set activity dependencies. By continuing to place boxes on the screen, you build up a PERT chart of your project. This is a quick way to lay the groundwork before filling in resources and costs on the Comprehensive Input screen. Conversely, you can go straight to the comprehensive screen and jump over to Easyplan later to see how things look.

If you choose the Comprehensive Input approach, you go first to a setup screen. Here you decide on a planning method: bar chart, precedence network, or arrow network. You don't see the bar chart or networks on the screen as you build your project; you have to create them through menus and setup screens. The two network approaches are mutually exclusive, but through the use of either approach you are

RESOURCE MANAGEMENT: AN IMPERFECT SCIENCE

Resource distribution histograms are measuring tools that graphically indicate not only where resource overloads and underloads occur in project planning, but also what their magnitudes are. Unfortunately, most histograms are restricted to displaying no more than two or three resources at a time.

With tabular resource-distribution reports, resource requirements over time periods are presented numerically. This provides accurate information for a greater number of resources at once, but the results may be more difficult to analyze, since resource fluctuations and their magnitudes are not that easy to catch with the eye.

As planning tools, resource distribution histograms and tables provide users with the best mechanism for manual adjustments of resource allocations, especially if they can be changed interactively on-screen. Manual changes made this way are equivalent to desktop publishing's WYSIWYG idea: any change made to the project's resources is reflected immediately and accurately, not only on the screen but throughout the entire project. Activity and assignment changes are made on a Gantt chart (or any activity-oriented chart or table) and reflected on a resource distribution histogram (or table).

Only a few users take full advantage of resource management. Why? The fact is that even with the most-sophisticated resource-planning techniques, the results of automatic planning are far from satisfying. Schedules must always be revised and carefully analyzed so that necessary changes are made before the actual project implementation begins. The fine-tuning and analysis of the schedules require more time and effort than most users are willing to invest.

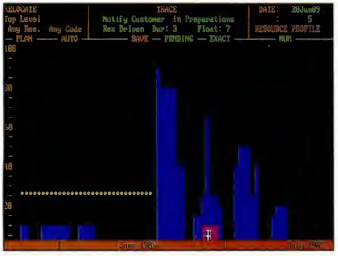
It's disappointing that 30 years' experience with the critical-path method—and continued development efforts spurred by the microcomputer revolution—have not brought us better resource-planning tools. Is there any way to automate resource planning fully and produce schedules that need no further adjustments?

The resource-planning process requires specific judgments, many of them relevant only to individual situations. Only a few situations can be anticipated in advance, so very few rules have been developed that successfully resolve planning problems. You could develop specific rules for a large number of anticipated situations, but it wouldn't pay to develop them if they could not be used repeatedly. Programming algorithms can be effective only if one rule applies to all problems of the same sort. It may be impossible to find rules that will completely refine the automatic resource-leveling procedure.

Rather than attempting to develop more rules, several software developers have provided users with additional tools for manual adjustments of resource allocations after leveling has been processed. A resource distribution histogram or table, integrated and synchronized with a Gantt chart, may be the most powerful tool for this job. But if a program is not extreimely quick (and high-end programs are generally slow), calculations involving hundreds or thousands of tasks can take too long to warrant developing interactive Gantt charts. Still, such charts can be useful if you want to resolve planning problems with high-end programs, because you can move an activity within a margin of slack time without rescheduling the whole project. This sort of live, interactive "what if" planning should be the software developer's goal.

—Daniel Yahdav

Daniel Yahdav is the president of San Rafael, California–based I Soft Decision. The company publishes PM Solutions, *an analytical report on project management software.*



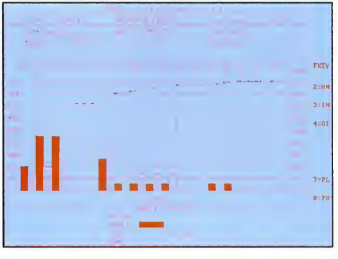
Like Qwiknet Professional*'s histogram,* ViewPoint*'s histogram is based on the block graphics method. By using the Resource Load Tracing function, users can point to overload/underload areas of the resource histogram on-screen and then trace and edit, interactively, any of the involved activities. When a user hits T, the trace function colors the assignment of the first activity involved in the loading and displays essential information about it. Users can impose a target date in order to move the activity to an underload area, or they can redistribute resource assignments.*



Qwiknet Professional*'s resource histogram includes a variety of options relating to chart type (interval, cumulative, total, or average), content (displaying 2 of the 12 resource/cost functions), and appearance (shape, color, axis origin, and more). The chart, which is based on block graphics characters, is displayed instantly. All of the control options are highly interactive and are accessed through a pop-up window. As a result, chart changes are reflected on the same screen, and users can verify immediately that they are getting what they want.*



With ViewPlot, Plantrac*'s graphics-oriented module, you can produce bit-mapped graphics (in a slow but very flexible procedure) and preview the resource charts for editing before plotting them. Editing functions include the ability to add lines and text of different sizes and thicknesses, and a zoom function is a welcome assistant. This chart, however, is not interactive: you can't alter the original project data and watch the results of the changes immediately on the* ViewPlot *screen.*



SSP's Promis *offers an on-screen resource histogram made of bit-mapped graphics that can be zoomed in or out. The program lets you produce up to three different schedules with interval or cumulative distributions of early, late, or current schedule information for a single resource or a range of resources. Users can customize headings and the chart layout, but the customization procedure is not controlled from within the histogram, and project data is not accessible from it.*



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Tracker Option: Actual progress comparison with Baseline Plan, Earned Value, Variance and C/SCSC Analysis. Project History Database™ reports manpower and cost by period.

NotePad Option: To detail each assignment and document progress.

#1 Ease Of Use/Overall Value
Among Project Management Buyers, PC Week Poll of Satisfaction, 11/88

"It's well designed, complete, fast, powerful, and inexpensive."
Ezra Shapiro,
BYTE Magazine.

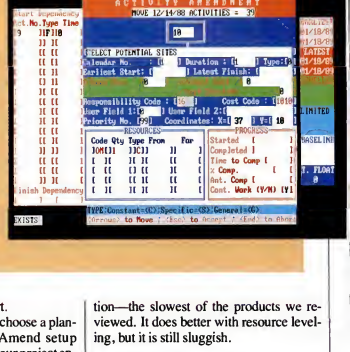
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■ PROJECT MANAGEMENT SOFTWARE



Plantrac offers two interfaces. If you choose the comprehensive interface, shown here, you can design the way your data entry screen will appear. The screen shows a full complement of data fields permitting the user to enter activity, resource, dependency, progress, cost, and code information. You can choose a single data type—activities or resources—or any combination. The little colored boxes on the right show project dates.

also able to obtain a bar chart.

In addition to letting you choose a planning method, the Create/Amend setup screen lets you design how your project entry display will look. To start with, you might want only the activity fields. After entering the activity number, you have a description field and other data-entry fields, which are connected white areas on a blue background. At first the heavily blocked-out entry area and the color changes are disconcerting because they all draw your eye at once. After a while you get used to the design, but it isn't too attractive.

From this simple screen you can add layers of input—one at a time—until you have an intricate array of resource, cost, code, dependency, and progress fields, with a mixture of activity dates and available float displayed down the left side of the screen. You can change this display at any time.

The project data you can enter is sweeping. For activities you can assign a calendar, a type designation, a priority level, and even *x*- and *y*-coordinates for the network plots.

Plantrac doesn't automatically calculate the schedule when you're done entering activities. You initiate the process through the Time Analysis feature, which will send detailed results to your printer. *Plantrac* is quite slow at this calculation—the slowest of the products we reviewed. It does better with resource leveling, but it is still sluggish.

RESOURCE AVAILABILITY Resource availability is handled thoroughly by *Plantrac*. Resources are written to a resource file, which means that they can be pulled up as a group, to be used in other projects. A cost file is used the same way. A library feature enables you to save sections of a network or a whole subproject structure.

A resource can have as many calendars with quantities and availability dates as you like. Unfortunately, each new resource or resource set has to be entered individually because the resource availability form is one line. This is one of the more-irksome aspects of *Plantrac*, because it is fairly slow at writing to disk and at changing the screens.

Resources can have both a "cost if used" and a "cost if unused." These cost figures are not tied to units of measure, so they can reflect the time measurement of the project—weeks, days, hours, or minutes—or they can vary from one resource to another.

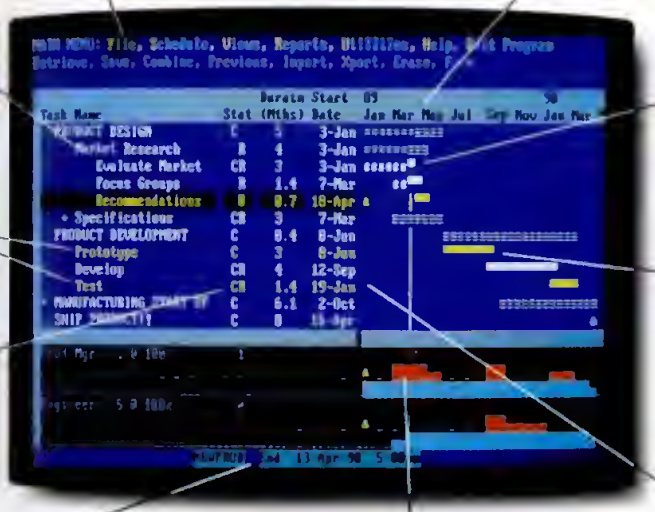
You assign resources to an activity for "constant," "specific," or "general" use. A constant resource is available during every working day of an activity; a specific resource is available from one particular day to another, and a general resource

GREAT GANTTS.

***Lotus-like menus** give Time Line a familiar-looking face, which makes it easier to learn... and easier to work with.*

***Display your schedule** in years, months, weeks, days, hours, minutes... any way that helps you clearly see the timing of your project.*

***Time Line's flexible outline structure** puts you in control. Collapse the entire schedule, to see "the big picture." Or expand a section to focus on details.*



***It's easy to see progress,** indicated by the broken portion of the task bar.*

***Four filters** make it easy to view selected information, such as "Joe's critical tasks."*

***Changes are automatically** reflected throughout your schedule. You get the power to quickly find and fix conflicts, before they become real problems.*

***For easy reference,** the status column flags tasks that need special attention—like critical tasks or resource conflicts.*

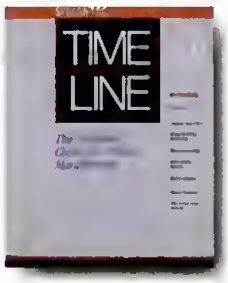
***Your project's end date** always shows on-screen. So, whenever you make a change, you'll immediately know how it affects the end result.*

***See the impact of any changes** you make immediately in the resource histograms. This, and Time Line's Undo/Redo feature make playing "what-if" an exact science.*

***Customize your Gantt** with up to 16 data columns, from 60 options. That way, the Gantt chart fits the way you work. Perfectly.*

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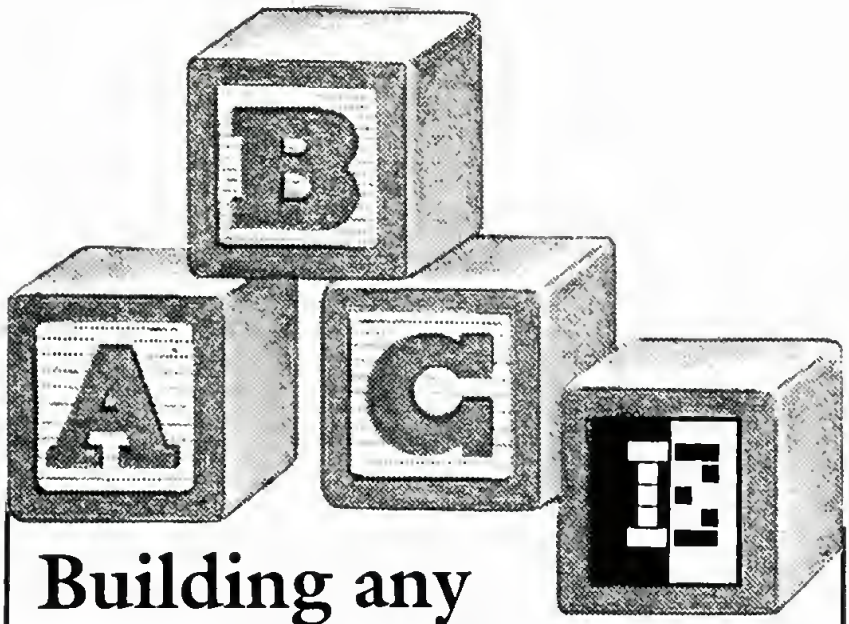
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Time Line is the #1 best-selling project manager (Survey of National Distributors). It also received InfoWorld, PC Magazine and Software Digest's highest 1988 ratings for project management programs. †In Canada call 800/228-4122 Ext. 565. Training and consulting services available, call 415/898-1919. © 1989 Symantec Corporation

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is rationed evenly across the activity duration.

For reporting purposes, it would be nice if you could identify a resource by type (such as labor, materials, or equipment). Another drawback is that you can assign only five resources to each activity.

Plantrac offers both types of resource scheduling—leveling and limiting—and it goes a bit further. You can let resources have an acceptable excess (if you know that an additional quantity can be acquired). Also, you can temporarily change a resource's availability or split activities. Leveling and limiting both work across multiple projects.

Plantrac is the only program we reviewed that lets you link separate subprojects by interface activities. Thus you can connect 100 subprojects and do critical-path analysis on half a million activities (each subproject can have up to 5,000 activities).

Although *Plantrac* includes the Easyplan graphics interface, the program is really command- and forms-oriented. Almost every procedure requires going through several layers of cumbersome menus or setup forms. For example, if you want a Gantt chart, you have to go through seven specification screens before you see it. One of those screens, Selection Options, has 15 choices for activities. The Detailed Selection screen has 18 data-range options. The other screens cover data sequence, formats, bar-chart particulars, printing, and saving.

To produce any graphic or tabular report in *Plantrac*, you go through this rigmarole. The program does have good sorting ability and also lets you customize column order and size, rename headings, and enter spaces between fields.

Plantrac's graphics are quite nice. Besides obtaining the histogram, Gantt chart, and network diagram, you can preview and edit sophisticated plotter output on-screen. A merge feature lets you combine different graph types on one page.

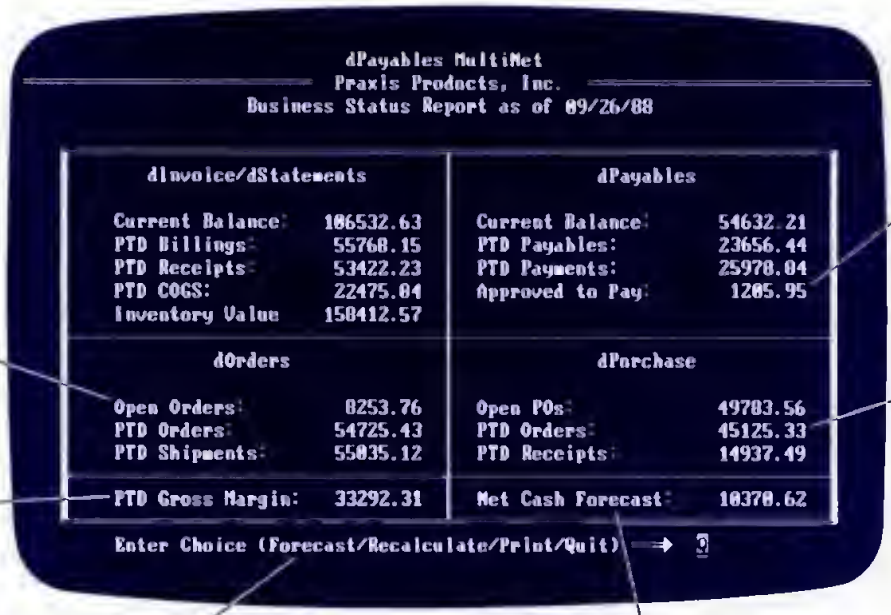
The program has many extras. You can store up to 5,000 comments on the project or activities, perform a global search-and-replace, undo your work, and run executable programs without exiting.

For a program that is so malleable, the manuals are lamentably poor. It's hard to

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11:06
"Gross Margins look good. We can pick up sales volume with some promotions."



11:07
Let's forecast where these numbers will be at the end of the month."

11:08
"Last week's cash forecast was $4,000. We're looking much better. We can put some into CD's."

11:09
"Cash receipts are up, I can approve a few more P.O.'s."

11:10
"Purchase Orders are close to sales this month. I'll call Mary and put the brakes on any more P.O's for a while."

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find complete information on topics, and the print is often dense. Aside from this problem, *Plantrac* is quite solid. The program's wide spectrum of interfaces makes it accessible to just about any serious project manager.

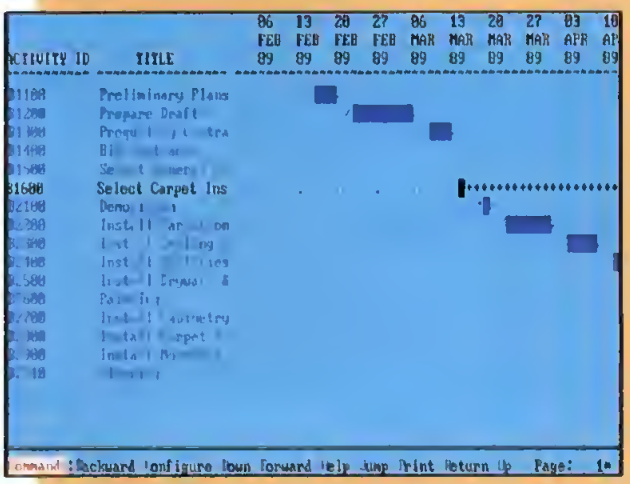
Primavera Project Planner

Primavera Project Planner gives you excellent control over both the structure and the minutiae of a project. By using a series of dictionaries, you are able to chisel out the main project features. Then, by maneuvering through the data-entry windows in the midst of the activity form, you perfect it by doing the fine sculpting and polishing of a schedule. *Primavera* allows you to update with the same dexterity, and the program's practical command techniques are simple, comprehensive and easy to use. If you're willing to add an extra $1,500 to your budget, the *Primavera Project Planner* will present your project results in admirable, vivid graphic hues as well.

The most efficient way to build a project in *Primavera* is by going to its three dictionaries first. Through the Activity Codes, Resources, and Cost Accounts dictionaries, you define a work breakdown structure, record resource availability, and establish cost account numbers for tracking expenditures.

You could bypass the dictionaries and go directly to the Activity Entry screen, but doing so makes the full functionality of the program harder to access. It's difficult to impose order after the fact on a simple numeric or alphabetic sequence of activity IDs. *Primavera* is distinguished by the astounding number of codes you can assign to activities and costs. These codes are like a fine set of jeweler's tools, to be used for very precise adjustments in project views and reports.

Activities offer the richest coding possibilities. Every activity can have four ID codes, strung together to make one 10-character ID. These codes can correspond to levels in a work breakdown structure or to subprojects. In addition, activities get up to 20 codes (totaling no more than 64 characters) that can be used to select and summarize by stage, responsibility, location, subcontractor, vendor, department, and so on. The codes can have an unlimited number of values. Thus, if you use one code for project phases (PHAS), you can have as many PHAS values—1,000, 2,000, 3,000—as you want, and each will have an accompanying title. All of the code values for a particular activity are clearly displayed on the top strip of its entry form.



In Primavera Project Planner, *you can select the activities you want to see in a Gantt chart. The one shown at left was created by selecting all the "phase B" activities with a 1-day duration. The string of black plus signs represents an activity's available float time.*

LOOK IT UP The Resources dictionary allows you to identify an unlimited number of resources, but the program will automatically level (or monitor) only 40 of them. You can't level a schedule that has already been leveled—it will result in schedule errors. A limitation like this weakens a program intended for large projects.

Actually, the treatment of resources reveals the best and worst about *Primavera*. Underneath the name and description of a resource in the dictionary, the screen is split into a section for detailing limits and another for specifying prices. Resources have both normal and maximum levels of availability, linked to time periods during the project. You can specify six such limit sets, so you have a great deal of flexibility in defining resource availability. You also get six sets of resource prices tied to dates.

On the other hand, you're limited in resource leveling, there are no resource calendars, and resources can be assigned only by whole days. In fact, Version 3.1 has but one calendar for a project, and days are the only time units it allows. The next release of *Primavera* (now shipping but unavailable at the time of review) remedies these last two problems by having three activity calendars and allowing time units of days, weeks, and months. Version 3.2 also adds negative lag times (to plot overlapping tasks) and summarizes data from sub-

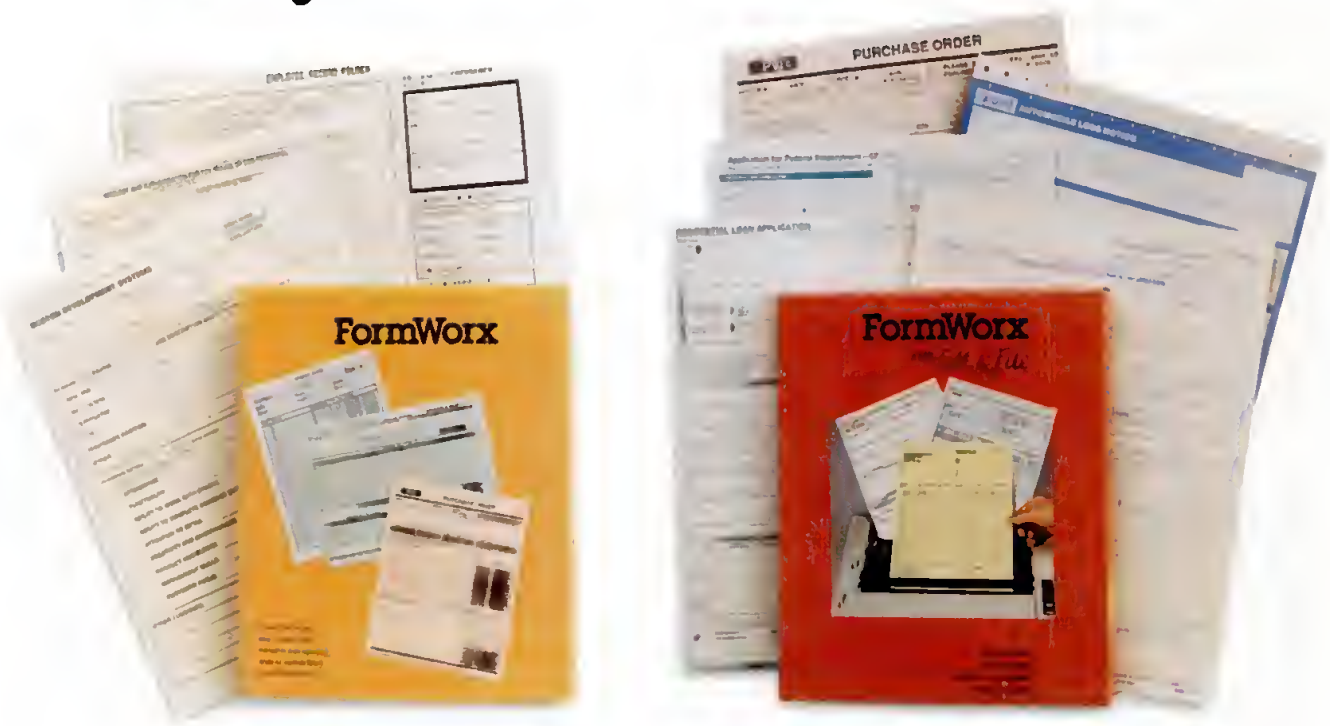
PC MAGAZINE FACT FILE



Primavera Project Planner
Primavera Systems Inc.
Two Bala Plaza
Bala Cynwyd, PA 19004
(215) 667-8600
List Price: $2,500; *Primavision* (plotter graphics program), $1,500.
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: *Primavera* offers you more coding ability than any other high-end program. You can detail resource availability thoroughly, but the leveling function is limited to 40 resources per project. The program has good progress and reporting features. It's expensive if you include the graphics package—and you can't produce a network diagram without it. Not copy protected.

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Project Management Software: Summary of Features

(Products listed in ascending price order)

Besides describing the six high-end project-management software packages we reviewed, this table includes a summary of the features of Symantec Corp.'s *Time Line*, a $595 package that, along with Computer Associates International's *SuperProject Plus*, was an Editor's Choice the last time we evaluated low-end project-management software (November 15, 1988). While *Time Line* does have many of the features of the more-expensive programs, it is less powerful in a few key areas—for instance, in the maximum number of tasks it can handle per schedule (1,000).

	Time Line	ViewPoint	Primavera Project Planner	Qwiknet Professional	SSP's Promis	Plantrac	Open Plan
NETWORK VERSION	$595	$1,995	$2,500	$2,500	$2,995	$3,000	$4,200
Cost of master program	$595	$2,990	$8,000 (4 users), $12,000 (8 users)	$8,600	$6,000	$3,000	$14,000 (4 users)
Cost per additional user	$195	$990	As shown above	$2,690	$1,200	$695	$1,500
Site license available	●	○	●	●	●	●	●
DISK AND MEMORY USAGE							
Disk space required	640K	2MB	2MB	1.5MB	3.5MB	2.1MB	2MB
Expanded memory	●	●	○	●	○	○	○
Extended memory	●	●	○	○	●	○	○
HARDWARE SUPPORT							
Hard disk required	●	●	●	●	●	●	●
Mouse support	○	●	○	●	●	○	●
VIEWS							
Gantt charts	●	●	●	●	●	●	●
Pert charts	●	●	●	●	●	●	●
Histograms	●	●	●	●	●	●	●
Other	None	Network trees, phase breakdown tables	Cash flow curves, cumulative curves, flow paths, tabular views	Tabular views	Histograms with S-curve, multiple Gantt charts, summary Gantt charts with multiple milestones, tabular views, time-scaled networks	S-curves, tabular views	Cash flow curves, combined Gantt chart and histogram, cost curves, earned value curves
ORGANIZING TOOLS							
Work breakdown structure (WBS)	●	●	●	●	●	●	●
Organizational breakdown codes	●	●	●	●	●	●	●
Subprojects	●	●	●	●	●	●	○
Automatic roll-up	●	●	●	●	●	●	●
Multiple projects	●	●	○	●	●	●	●
CUSTOMIZING TOOLS							
Project journal	●	○	○	●	○	●	●
Notes	●	○	●	○	●	●	●
Named layouts	●	○	●	●	●	○	●
Named filters	●	●	○	○	●	●	●
Wildcards, criteria	●	●	●	●	●	●	●
Sorts by field	●	●	●	●	●	●	●
TASK MANAGEMENT							
Maximum number of tasks per schedule	1,000	65,000	10,000	5,000	2,000	5,000	10,000
"As soon as possible" (ASAP) task scheduling	●	●	●	●	●	○	●
"As late as possible" (ALAP) task scheduling	●	○	●	○	○	○	●
Fixed task	●	○	●	●	●	●	●
Task durations	Minutes, hours, days, weeks, months	Days, weeks, months	Days	Hours, days, weeks, months	Days	Minutes, hours, days, weeks, months	Minutes, hours, days, weeks
Dependencies	●	●	●	●	●	●	●
Task priorities	●	○	●	●	○	●	●
Maximum schedule duration	25 years	100 years	20 years	53 years	100 years	8 years	500 years

—Editor's Choice ● —Yes ○ —No

N/A —Not applicable: product does not have this feature.

	Time Line $595	ViewPoint $1,995	Primavera Project Planner $2,500	Qwiknet Professional $2,500	SSP's Promis $2,995	Plantrac $3,000	Open Plan $4,200
RESOURCE MANAGEMENT							
Maximum number of resources per schedule	300	65,000	Unlimited	1,000	Unlimited	200	500
Maximum number of resources per task	24	65,000	11	1,000	11	5	250
Partial resource allocation	●	●	●	●	●	●	●
Resource-driven scheduling	●	●	●	●	●	●	●
Automatic resource leveling	●	●	●	●	●	●	●
Individual resource leveling	●	●	●	○	●	●	●
Cross-project resource leveling	●	●	●	●	●	●	●
Resource histograms	●	●	●	●	●	●	●
Resource calendar	○	○	○	●	○	●	●
TRACKING FEATURES							
Actual-vs.-planned Gantt charts	●	●	●	●	●	●	●
Baseline comparison	●	●	●	●	●	●	●
Percent complete	●	●	●	●	●	●	●
Cost tracking	●	●	●	●	●	●	●
Earned value analysis	●	●	●	●	●	●	●
REPORTS							
Custom reports	●	●	●	●	○	●	●
Resource reports	●	●	●	●	●	●	●
Cost reports	●	●	●	●	●	●	●
Status reports	●	●	●	●	●	●	●
Network reports	●	●	●	●	●	●	●
Cross-tab reports	●	○	●	●	○	○	●
Actual-vs.-planned reports	●	●	●	●	●	●	●
Variants reports	●	●	●	●	●	●	●
Gantt reports	●	●	●	●	●	●	●
PRESENTATION							
On-screen reporting	●	○	●	●	●	●	●
Maximum number of windows	2	2	2	80	N/A	4	2
FILE IMPORT EXPORT							
ASCII files	●/○	○/●	●/●	○/●	●/●	●/●	●/●
Delimited ASCII files	○/●	●/●	○/○	●/●	●/●	●/●	●/●
.DBF files	○/●	●/●	●/●	○/●	○/○	●/●	●/●
.DIF files	○/○	○/○	○/○	○/○	●/●	○/○	●/●
SYLK files	○/○	○/○	○/○	○/○	○/○	○/○	●/●
.WKS files	○/●	●/●	●/●	○/●	○/○	○/○	●/●
HELP, DOCUMENTATION, AND ERROR HANDLING							
On-line help	●	●	●	●	●	●	●
Context-sensitive help	●	●	●	●	●	●	●
On-screen tutorial	●	●	○	○	○	○	○
Error messages	●	●	●	●	●	●	●
Explaining error	●	●	●	●	○	●	●
Suggesting remedy	●	○	●	●	○	●	○
Free technical support	1 year	1 year	1 year	1 year	90 days	1 year	1 year

BARGAIN-PRICED POWER

SuperProject Expert doesn't have all the capabilities of monster-size project managers, but its $695 price tag makes the features it does have look tempting.

At $695, Computer Associates International's *SuperProject Expert* costs one-third as much as the least-expensive high-end project management packages, yet it rivals many of them in capabilities. Only its limit on the number of activities it can handle and a weakness in cost management prevent us from considering it a true high-end program.

The main demarcation between high-end and low-end programs is the number of tasks you can include in a project. All the programs we review here can handle a minimum of 2,000 activities. *SuperProject Expert* can't manage more than 400 to 700, depending on the number of resources, resource assignments, descriptions, and notes. *SuperProject Expert* keeps its project data in RAM, so it has only about 250K available for data in a 640K system.

The good news is that *Expert* supports LIM 3.2 and 4.0. With expanded memory, you get an additional 120K to 200K for data, effectively doubling the number of tasks you can have in a project.

Another way to breach *Expert*'s task limit is to chop a project up into subprojects. Only one subproject is kept in memory at a time, so you can have a project with an unlimited number of subprojects and tasks. Resource leveling won't cross subproject boundaries, however, and that's a severe limitation.

HOW IT WORKS *Expert* lets you build a project in five different ways: in an outline, PERT chart, Gantt chart, work breakdown chart, or activity table. One way or another, it fits every project management style. You can tweak these different approaches to suit your taste more precisely. For example, the outline view can include or exclude outline level names—which represent project phase names—or resource assignments. Another view shows tasks, resources, and notes, but none of the other task outline fields.

Because of the inherent nature of computerized outlines, time resources and costs are rolled up from the individual task level to each parent level. *Voilà!* automatic summarization and automatic work-breakdown structure.

The outline screen itself gives you the most complete view of your project. It's a row-and-column layout with the activity and resource names presented in a wide column at the left side of the screen. As in a typical text outline, task sublevels are indented. By scrolling to the right, you can see the task ID and duration, scheduled start and finish dates, variable cost, percent complete, earned value, schedule variance, and more.

When it comes to scheduling, *Expert* is just as good as the high-end programs. Activity durations can be in hours, days, or weeks. There are four activity types: ASAP, ALAP, Must, and Span (a Span task starts as soon as possible and finishes when all successor tasks are completed). You can choose to split activities to evince real-world conditions. Coding is not as rich as it is among the high-end programs, but there is a WBS (work breakdown structure) code, a task ac-

projects with different levels of detail.

In the Cost Accounts dictionary, you specify cost categories with one-character codes, such as E for equipment or L for labor (you can have six of them). You also enter cost account numbers (up to 11 characters long).

Once all the dictionary entries have been made, the project has a skeletal structure. Then it's time to enter activity data and assign the resources and costs. The top part of the Activity screen holds basic information: the activity ID; title; early, late, and actual start and finish dates; total float; percent complete; and activity codes. The lower two-thirds of the Activity screen is a window containing the fields for successor task information. By selecting Window from the menu, you can view a Predecessor window, a Budget window, or any of six others. This system makes entering project data very easy. It's like watching a TV that has an inset screen for viewing other channels.

Not only are the windows useful for entering data, they are great for reviewing project data later on. For example, the Budget and Financial windows display different aggregations of activity costs: budgeted quantity, quantity needed to complete, variance, and so on. The Dates window shows you current and target dates.

Schedule dates don't appear on the Activity screen until you have executed a schedule calculation. *Primavera* was fourth of the six products we looked at in scheduling speed (*SSP's Promis* and *Plantrac* were slower). *Primavera* was the slowest program at resource leveling.

RESOURCE LEVELING After a project is scheduled, the next major step is leveling the resources. To decide which resources need leveling, you would look at a resource histogram. Drawn across the chart are two horizontal lines, one for the normal resource limit and one for the maximum. If the usage bars stick up above one or both of these lines, then the resource needs to be leveled.

Primavera makes two passes through the schedule, first using the normal limit and available float. If activities still can't be scheduled, it jumps immediately to the maximum limit. Another technique, resource smoothing, can be used with leveling to step up resource use gradually in ten even increments between the normal and maximum limits. The late finish date of an activity is never compromised by the level-

count ID, and a resource work code.

Expert offers a scheduling feature called deviation which none of the high-end programs have. It's an estimate of uncertainty regarding a task's duration. You can enter it manually, or the program will calculate it according to optimistic, likely, and pessimistic duration entries. Deviation lets you hedge your bets and is particularly useful if task duration is a real unknown.

Resources and resource leveling are areas where *Expert* shines. A resource's availability is controlled by its calendar. You can specify the days a resource will be available, and even the hours it can be employed on those days. The one drawback in *Expert*'s approach to uneven availability is that you can't specify ranges, which most high-end programs allow.

The *Expert* program allows for both time-constrained and resource-constrained leveling on all resources at once. The leveling is affected by task priority settings. Resource use is shown on a histogram and a Gantt chart. Overscheduled resources are indicated by blinking symbols on the task and resource Gantt charts; the number of hours a resource is overscheduled appears on the resource details screen and the outline screen.

Costing is where *Expert* is somewhat overshadowed by the high-end programs. You can assign costs to the beginning or end of a task, or prorate them. You can also attach variable and fixed costs to a task, but you can't indicate overtime costs, profits, or any form of cost increase by date.

Progress and reporting are close to high-end standards. You enter progress in terms of percent complete, actual dates, and actual cost. *Expert* has a wide range of tabular reports, including cross-tab reports, and it supports plotters. A third-party program called *MultiGantt* ($195), available from SofTrak Systems in Salt Lake City ((801) 973-9610), lets *Expert* users produce a time-scaled PERT chart.

With all its high-end characteristics and its comparatively low price, *Expert* is worth serious consideration—but only if your projects don't run larger than 1,000 to 1,400 tasks.

—Henry Fersko-Weiss

PC MAGAZINE FACT FILE



SuperProject Expert
Computer Associates International Inc.
1240 McKay Dr.
San Jose, CA 95131
(408) 432-1727
List Price: $695
Requires: 384K RAM (640K recommended), hard disk, DOS 2.0 or later.
In Short: An almost-high-end package with low-end price, *SuperProject Expert* is a more capable sibling of *SuperProject Plus*. It can handle up to 1,400 tasks in one project, competing respectably with expensive high-end project managers.

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ing procedure, assuming the project is constrained by a finish deadline. If no fixed end date exists, the program automatically goes from leveling within the float to stretching the project schedule in order to accommodate the resource availability.

The Activity screen and its windows let you see one activity at a time. To see groups of activities, you use the AutoSort and View features. AutoSort lets you select activities by the typical conditions: "equal to," "not equal to," "within range," and others. Selection parameters include early start, total float, variance from early target, resource, percent complete, and so on. *Primavera* allows four successive levels of selection, with up to seven parameters per level. This gives you tremendous precision in selection. Then, by going through the Order window, you can choose up to 16 sort orders.

The result of AutoSort is a set of Activity screens you can flip through one at a time or scan together with the View command. View lets you create a tabular format, bar chart, or histogram. These data views aren't formal reports, so you can't customize them. For instance, the bar chart will show only 20 characters of your activity titles, and you can't change that format. Both the tabular view and the bar chart show 20 activities at a time.

Primavera makes use of the typical array of progress techniques. You can enter percent complete, remaining duration, or the actual start and finish dates, but there is something unusually sophisticated about the way you get to utilize these techniques. The AutoCost feature lets you control the rules used to calculate cost and resource updates. For example, percent complete and remaining duration, which normally mirror each other, can be uncoupled. In reality, remaining duration may not always reflect the percent complete, so unlinking them makes it possible to model those situations. You can change *Primavera*'s half-dozen calculation rules for all projects or for a particular project. While the rules shouldn't be changed casually, this ability gives you a great deal of power.

Reporting is another area where *Primavera* excels. In addition to having a fine selection of standard reports, you can generate custom-designed reports by controlling the content, format, selection, sort order, target, and time scale.

Primavera is a program of great pluses and minuses. One of the minuses is its price—$4,000 including the additional

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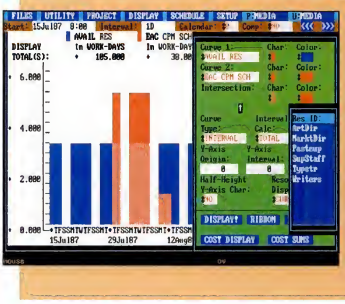
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graphics capabilities of *Primavision*—which puts it near the top of the high end. By itself, however, *Primavera Project Planner* has very limited graphics. For example, you can't produce a network diagram, even though the project you create adheres internally to a precedence or arrow network methodology. Because of this, *Primavision* is a must. With it, the program has first-rate graphics and is equipped to handle the largest projects with dexterity.

Qwiknet Professional

Qwiknet Professional has a fully fleshed-out approach to project scheduling. It lets you record and review detailed information on project activities, resources, and costs. The program is also fast, and it's the least expensive of the high-end packages we reviewed. Its fine user interface combines pull-down menus, pop-up forms, and explanatory message screens with mouse support, a Quick Pick facility, and windowing.

Pull-down menus and pop-up forms have become the sine qua non of high-quality user interfaces; just like other programs, *Qwiknet* uses them to advantage. But the program's windowing facility is not typical. Every display screen, form, message box, and menu is in a window. As many as 80 windows can be open at once. They can be sized, moved, or colored to your liking.



Qwiknet Professional *lets you define an on-screen report that shows you a Gantt chart preceded by any number of data columns. This report is accessed through the Display menu and is updated automatically as you enter project information. It will retain the same format until you redefine it.*

The beauty of *Qwiknet*'s window interface becomes apparent when you add resources to the activities in a project. From the window showing a Gantt chart of your project, you open windows for resource assignment, available resources, and editing activity information. The last two windows overlap each other and can be flip-flopped with a click of the mouse. The mouse also enables you to quickly slide across the windows on the screen to any visible field.

Using the Quick Pick feature, you can click on an activity name in the Gantt chart or a resource name in the availability window and then deposit a copy of it into the resource assignment window. All the windows are integrated, so changing the information in one instantly changes the others. When you are done assigning resources, four quick clicks with the mouse close all the windows, leaving only the Gantt chart.

The main scheduling window in *Qwiknet*, called the Network, is also a Gantt chart. Its time scale shows intervals in any whole number, such as 2 weeks or 4 hours. The rest of the Gantt chart is rigidly predetermined. The activity bars are each made up of two parallel lines; they fill in as an activity is completed. Critical and noncritical activities are differentiated by float—a series of plus signs. Weekends and holidays appear as capital *N*s or *H*s in the midst of bars. The symbols harken back to a more primitive type of graphics, and none of them can be changed .

A Gantt chart comparing two schedules becomes a jumble of crude symbols. The bars for each schedule are combined on one line; the first schedule's bar symbol is a downward-pointing triangle and the second schedule's symbol is a little box. Capital *X*s mark the overlap in the two schedules. If this weren't confusing enough, these combined bars also have *N*s and *H*s. A screenfull of these bars can be overwhelming.

The Gantt chart can become part of another display, called the Current Schedule. That window is basically a screen report showing columns of project data. There you can see things like the early and late start and finish dates, the budgeted cost, remaining duration, and cost variance, as well as the Gantt chart. The ability to customize a detailed overview of your project is extremely helpful.

One of the other typical graphic views of a project is the PERT chart, or network diagram, showing the flow of work without showing the element of time. *Qwiknet*'s version of this is very weak. The activity boxes don't show whether a task is

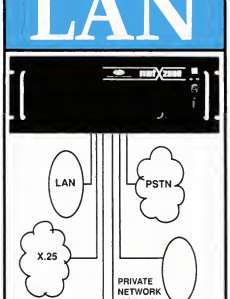
FACT FILE



Qwiknet Professional
Project Software & Development Inc.
20 University Rd.
Cambridge, MA 02138
(617) 661-1444
List Price: $2,500
Requires: 512K RAM, hard disk, DOS 2.0 or later (DOS 3.0 or later for the Graphics program).
In Short: In *Qwiknet Professional*, every screen is a window. You can have 80 windows open at once, and they can be moved and sized. The windows let you jump quickly from one function to another on-screen, making data entry a pleasure. The Gantt chart is crude, but with the Graphics program you can produce nice plots. *Qwiknet* has good multiproject facilities, it's fast, and it's the least expensive of the high-end products. Not copy protected.

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critical or not; you see very few activities at once, and you can't zoom in or out on the diagram. However, a full network diagram can be printed out.

GRAPHICS FUNCTIONS The included *Qwiknet Graphics* program generates very attractive Gantt charts, network diagrams, histograms, and even a time-scaled network diagram. It supports a great variety of plotters.

Qwiknet is a flexible scheduler. You can enter project and activity constraints and priority numbers. The constraints force things to occur on a certain date, no earlier than the specified date, or no later than the specified date. These constraint parameters are factored into the critical-path analysis.

■ *Qwiknet* can recalculate a schedule with 200 activities in less than half a minute—making it the second-fastest scheduler.

Lead and lag times for an activity are specified when you enter dependency relationships in the Logic window. *Qwiknet* lets you assign multiple dependencies. For example, an activity's tasks could have a start-to-start relationship with 5 days of lag time and a finish-to-finish relationship with 8 days of lag time. Activities can have up to four dependencies at once.

While *Qwiknet*'s approach to activities and scheduling is quite thorough, it's missing ALAP ("as late as possible") activities. There is no way to schedule backwards from an end date. The ability to set constraints lessens this problem somewhat, but the constraints don't lead to true backward scheduling, which is important for some projects.

Qwiknet is quite fast at recalculating the critical-path schedule if you make a change. It can recalculate a schedule with 200 activities in less than half a minute. This makes it the second-fastest scheduler among the high-end products, surpassed only by *ViewPoint* in this respect.

Resources and costs can also be finely detailed in *Qwiknet*. Just as with activities, resources get a description and calendar assignment, but only one code field. Resources can be entered as labor, materials, equipment, subcontractor, or ODC (other direct costs)—a comprehensive list. You can also indicate whether the resource is depletable. Availability of a resource is controlled by its calendar and by up to six time periods of special availability. You allocate resources—and therefore costs—in four ways: all at the beginning, at the end, evenly over the entire duration, or at a specified rate.

In the cost-display window, the *Qwiknet* program lists 12 cost/usage equations. They include categories such as estimated cost to complete, actual cost, budgeted cost, earned value, and cost variance. These equations can be used to generate histograms and tabular reports.

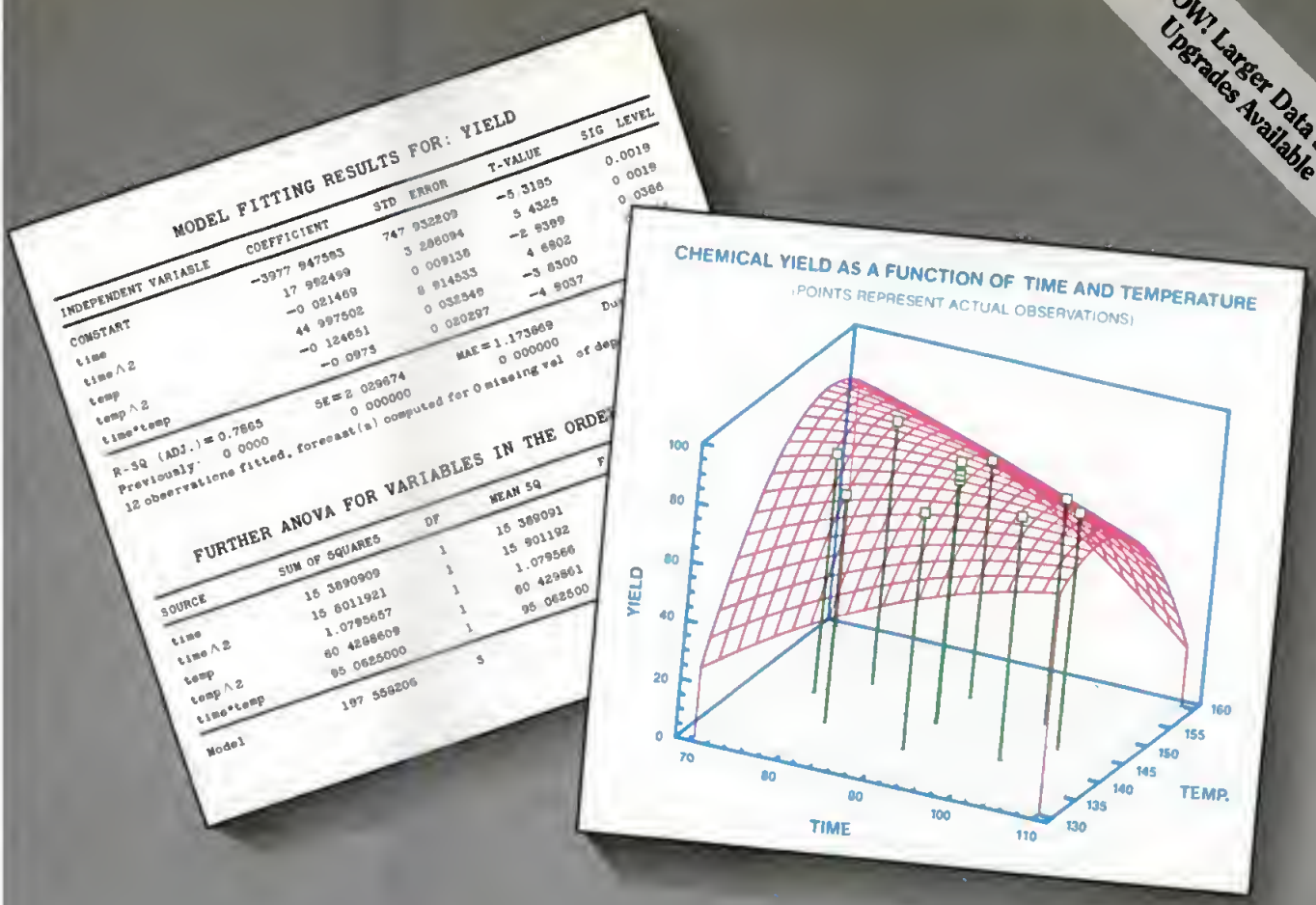
RESOURCE LEVELING *Qwiknet* offers two approaches to resource leveling: resource-limited and time-limited. With both methods, the program produces a resource schedule having early and late start and finish dates, just like a critical-path schedule. Resource-limited schedules start activities only when all of the required resources become 100 percent available. Time-limited scheduling considers both time and resource availability, but activities can't start later than their critical-path late-start times—even if resources are unavailable. Having both methods of resource leveling gives planners much more flexibility in figuring out a workable project schedule.

Qwiknet proved fairly slow at resource leveling—which was a surprise, given its speed at critical-path analysis. (*SSP's Promis* and *Primavera Project Planner* were slower).

After resources are leveled, information and warning messages are sent to the screen or to your printer detailing changes to the schedule and remaining problems. These messages make it easy to find and fix resource conflicts.

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you get to record while planning a project serve you well in the project's tracking phase. Progress data is entered by activity: You can put in actual start and end dates, elapsed time, remaining duration, or percent complete, or you can change the original duration. To see how you are doing, you can compare your current status with a target schedule.

Reports also help in tracking a project. *Qwiknet* has 26 standard reports and lets you define other tabular reports. The sort and select commands are quite robust, giving you a way to customize the reports. You can alter the column widths and control page breaks. You can't do creative report writing, however—you're stuck with the tabular presentation.

One of *Qwiknet*'s other strengths is its ability to manage multiple projects. It can handle 250 of them at once while maintaining separate calendars and resources, and it can level resources across the projects. This ability, in combination with its unique interface, makes *Qwiknet* a project manager worth consideration.

SSP's Promis

SSP's Promis brings a highly ordered sensibility to project planning. Functions are broken down into small, well-prescribed steps. Reports are bounded by the field selection the program allows, and a project can have no more than 2,000 activities. This degree of order makes it hard to make a mistake or lose your way. There is much to be said for these benefits, because high-end project management programs are generally complex and difficult. On the other hand, order can be confining and frustrating.

The screen design in *Promis* is clean and simple—the eye is never overtaxed by entry fields or command options. There are three types of screens: menus, data entry, and results. The menu screens let you use the function keys to make selections. In fact, all the program's commands are invoked by function keys.

The first screen in *Promis* is the Entry screen. It's a security checkpoint before you get into the program proper. It requires the correct user name and password. Next is the Master Menu, which is the central intersection of functional pathways in the program. Pressing F3 at this menu leads you to all the Data Entry screens, F5 leads you down the road to reports, and so on.



In SSP's Promis, *same screens come up in pieces as you accept IDs. The asterisks next to the ID fields in this screen indicate must-fill fields that are also the keys to screen sections. Once an ID is entered and accepted, a lower portion of the screen becomes visible. The OH & Profit field gives users the opportunity to specify a percentage for calculating a resource's overhead or profit.*

ID NUMBERS Every screen in *Promis*, except for the graphic reports, has an ID. This is useful because the ID actually tells you the route to the screen. For example, the Individual Activity entry screen ID is 3111, because from the Master Menu you press the key sequence F3, F1, F1, F1 to get to it. By learning the most-critical screen IDs you can get places much quicker, because you don't have to ponder menu selections along the way—just press the right keys in rapid succession and you're there. And *Promis* is a thicket of screens. To get to the detailed part of the Resource Assignment screen—with an ID of 322—you have to go through five screens and screen parts. Some screens have a six-number address. Then, to get back to the Master Menu intersection, you have to back up step by step using the Esc key.

Promis has taken some of the arduousness out of this process by letting you leap directly to the other important data-entry areas—such as the Precedence Relationship, Resource Assignment, and Cost screens—from the Activity screen. Also, similar operations are grouped together to make it easy to move among them.

Data Entry screens typically come up in pieces. For example, if you're entering new resources, the first part of screen 333 is the resource ID. You have to accept it with the F10 key before the second part of the screen (which is for entering resource details) becomes visible. Some entry screens, such as the Resource Assignment screen, have three parts. The reason for this lockstep approach to entering data is that every time you enter an activity or resource ID, the program calls on the database for verification and a description. If none is there, you get a blank entry screen; otherwise you get to see the appropriate description. The problem with this approach is that it forces you to use the F10 key frequently—which feels unnatural to a typist—and the program is slowed down by writing to the screen for each new section.

Once you get to *Promis*'s functionality, it gives you good control over scheduling. Activities have a calendar assignment, a 20-character ID, a description field, a responsibility code of ten characters and three auxiliary codes of the same size. There are seven time-constraint options for an activity. They include "start not later than" and "finish not earlier than." A separate screen is used to enter unlimited activity notes.

There are two scheduling limitations in Version 3.0. First, activity durations must be recorded in day units. SSP says that in the next version—due out in the fall—

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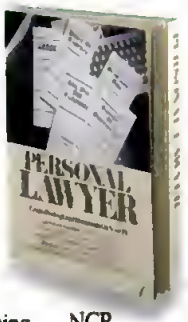
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- ☐FormTool 2.01 ..... 55.
- ☐Form Filler 2.0 ..... 89.
- ☐Personal Lawyer 2.0 ..... 39.
- ☐PopDrop 3.1 ..... 32.

Borland International ... NCP
- ◨Superkey 1.1 ..... 69.
- ◨Turbo C 2.0 ..... 99.
- ◨Turbo C Professional Pack *(w/Debugger)* ... 169.
- ◨Turbo Pascal 5.0 ..... 99.



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☐*Personal Lawyer 2.0*–Personal Lawyer employs a quick and easy "question and answer" method to create on your PC a will, power of attorney or guardianship statement, promissory note, or residential real estate lease ..... $39.

- ◨Turbo Pascal Professional Pack *(w/Debugger)* ..... 169.
- ◨Prolog 2.0 ..... 99.
- ◨Turbo Assembler & Debugger 1.0 ..... 99.
- ◨Sidekick Plus 1.0 ..... 135.
- ◨Sprint 1.0 ..... 135.
- ◨Quattro 1.0 w/SQZIPlus 1.0 ..... 165.
- ◙Paradox 3.0 ..... call

Bourbaki ... NCP
- ☐1DIR+ 3.0 ..... 49.

Bridgeway Publishing ... NCP
- ☐FastTrax 3.9 ..... 35.

Broderbund ... CP
- ☐Print Shop 2.41 ..... 39.
- ◙Memory Mate 3.01R *(NCP)* ..... 45.

Chipsoft ... NCP
- ◨TurboTax Personal/1040 6.01 ..... 45.

Chronos Software ... NCP
- ◙Who•What•When *(people, projects, time)* 119.

Computer Associates ... NCP
- ◙SuperCelc 5 ..... 319.

Core International ... NCP
- ☐Corefast 2.0 ..... 95.

Crosstalk Communications ... NCP
- ☐Remote² 1.1 ..... 95.
- ☐Crosstalk XVI 3.7 ..... 95.
- ☐Crosstalk MK.4 1.1 ..... 124.

Dac Software ... NCP
- ☐Dac Eesy Payroll 3.0 ..... 59.
- ☐Dac Easy Light 1.0 ..... 45.
- ☐Dac Eesy Accounting 3.0 ..... 59.

Datastorm ... NCP
- ☐Procomm Plus 1.1B ..... 49.

Delrina Technology ... NCP
- ◙Per:FORM 1.0 ..... 159.

5th Genaration ... NCP
- ◙Fastbeck Plus 2.01 ..... 109.

Fox Software ... NCP
- ◨Foxbase Plus 2.1 *(single user)* ..... 209.
- ◙Foxbase Plus 2.1 *(Network version)* ..... 319.

Funk Software ... NCP
- ☐Sideways 3.21 *(creates wide printouts)* .... 42.
- ◙Worksheet Utlities 1.0 *(1-2-3 utilities)* ..... 59.
- ☐Allways 1.0 ..... 85.

Genaral Information ... NCP
- ◨Hot Line Two 2.0 ..... $49.

Generic Software ... NCP
- ◙Generic CADD Level 2 ..... 89.
- ◙Generic CADD Level 3 ..... 179.
- ◙Estimator ..... 159.
- ◨Basic Home Design 3.0 ..... 35.
- ◨CADD Starter Kit *(includes Level 2)* ..... 109.

Great American Software ... NCP
- ☐One Write Plus Master 2.01 *(General Ledger)* 129.
- ☐AP, AR, or Payroll 2.01 ..... each 129.

Harvard Associates ... NCP
- ◨PC Logo 3.0 ..... 59.

Hayes ... NCP
- ◙Smartcom II 3.0 ..... 89.
- ◙Smartcom III 1.0 ..... 149.

Hilgraeve Software ... NCP
- ☐HyperACCESS 3.31 ..... 89.

Individual Software ... NCP
- ◙Typing Instructor Encore 2.13 ..... 26.
- ☐Professor DOS *(with Smartguide)* ..... 27.

Intuit ... NCP
- ◙Quicken 2.1 ..... 35.

Javelin ... NCP
- ◨Jevelin Plus 2.02 ..... 249.

Lifetree ... NCP
- ☐Volkswriter 4 ..... 159.

Lotus ... NCP
- ◙Agende 1.0 ..... 289.
- ☐1-2-3 2.01 *(upgrade free to version 3.0)* ... call
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- ☐Symphony 2.0 ..... 459.
- ☐Megellan 1.0 ..... call
- ☐Freelence Plus 3.0 ..... 345.

MECA ... NCP
- ◙Checkwrite Plus 1.0 ..... 29.
- ☐Meneging Your Money 5.0 ..... 119.

Meridian Technology ... NCP
- ☐CarbonCopy Plus 5.0 *(2 required)* ..... 115.

Micro Logic ... NCP
- ☐Tornado 1.8 ..... 55.

Microlytics ... NCP
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- ☐GOfer 1.0 *(text retrieval system)* ..... 45.



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- ☐ *Upgrade to Release 5 from any version* ... 89.

Microrim ... NCP
- ◙ R:BASE for DOS *(version 2.1)* ..... 489.
- ◙ R:BASE Compiler ..... 629.

Microsoft ... NCP
- ☐ Learning DOS 2.0 *(for any DOS version)* .. 35.
- ☐ Windows 286 2.1 ..... 69.
- ☐ Works 1.05 ..... 99.
- ◙ Windows 386 2.1 ..... 129.
- ◙ Word 5.0 ..... call
- ◙ Excel 2.1 *(requires 80286/80386 CPU)* .. 239.

LANGUAGES
- ☐ Quick BASIC 4.5 ..... 69.
- ☐ Quick C 2.0 ..... 69.
- ■ Macro Assemblar 5.1 ..... 99.
- ■ Basic Compiler 6.0 ..... 199.
- ■ C Compiler 5.1 ..... 299.

Monogram ... NCP
- ◙ Dollars and Sense 3.1 ..... 105.

Multisoft ... NCP
- ☐ Supar PC Kwik 3.2 *(disk cacha utility)* .... 49.
- ☐ Super PC Kwik Power Pak 1.1 ..... 59.

Nantucket Software ... NCP
- ◙ Clipper *(Summer '87, dB3 Plus compiler)* 429.

New England Software ... NCP
- ◙ Graph-in-the-Box Relaase 2 ..... 75.
- ☐ GB-Stat 1.0 ..... 159.
- ◙ GB Analytic 1.0 ..... 105.

Nolo Press ... NCP
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- ☐ For Tha Record 1.0 ..... 35.

North Edge Software ... NCP
- ☐ Timeslips III 3.3 ..... 169.

Owl International ... NCP
- ☐ Guide 2.0 ..... 143.

Paperback Software ... NCP
- ☐ VP-Info 1.4 ..... 65.
- ☐ VP-Plannar Plus 2.0 ..... 145.
- ☐ VP-Expert 2.02 ..... 145.

Paul Mace ... NCP
- ☐ Nvelope 1.02 ..... 29.
- ☐ HTest—HFormat 2.0 ..... 49.
- ☐ Mace Utilities 5.0 *(DOS utilities)* ..... $55.
- ☐ Maca Gold 1.0 ..... 79.

PC Support Group ... NCP
- ☐ Lightning 4.82 ..... 39.
- ☐ Lucid 3-D 2.0 ..... 75.

Parsonics ... NCP
- ☐ SmartNotes 2.0 ..... 49.
- ☐ SeeMORE 1.02 ..... 49.
- ☐ Look&Link 1.01 ..... 59.
- ☐ Ultravision 1.1 ..... 79.

Peter Norton ... NCP
- ◙ Norton Editor 1.3 ..... 39.
- ◙ Norton Commander 2.01 ..... 45.
- ◙ Standard Utilities 4.5 ..... 55.
- ◙ Advanced Utilities 4.5 ..... 79.
- ■ Dan Bricklin's Demo Program 2 ..... 99.

Quarterdeck ... NCP
- ☐ Expanded Mamory Manager 4.2 ..... 39.
- ☐ DESQView 2.2 ..... 79.
- ☐ DESQView 386 1.0 ..... 115.

Reference Software ... NCP
- ☐ Grammatik III 1.07 *(electronic proofraader)* 52.
- ☐ Refarance File 1.0 *(pop-up DB manager)* .. 49.

Relay Communications
- ☐ Relay Gold 3.0 ..... 149.

Revolution Software ... NCP
- ◙ VGA Dimmer 2.01 *(screen saver)* ..... 19.
- ◙ Cruise Control 3.02 ..... 39.

Rightsoft ... NCP
- ☐ Rightwritar 3.0 ..... 54.

Simon & Schuster ... NCP
- ☐ Typing Tutor IV ..... 33.

Softlogic Solutions ... NCP
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- ◙ PFS:First Graphics 1.0 ..... 95.
- ◙ PFS:First Choice 3.01 ..... 99.
- ◙ Profassional Writa 2.1 ..... 145.
- ◙ Professional File 2.0 ..... 189.
- ◙ Office Writar 6.1 ..... 299.
- ◙ Harvard Graphics 2.12 ..... 299.
- ◙ Harvard Graphics Accessories Pack .... 299.
- ◙ Harvard Project Manager 3.0 ..... 439.

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- ☐ Resuma Kit 1.0 ..... 25.
- ☐ 8-in-1 ..... 39.
- ◙ Splash 1.0 ..... 59.

Springboard ... NCP
- ☐ Newsroom Pro 1.0 ..... 45.

Symantec ... NCP
- ■ SQZ!Plus 1.11 ..... 69.
- ◙ Q & A Write 1.01 ..... 135.
- ◙ Grandview 1.0 ..... 195.
- ☐ Q & A 3.0 *(database, word processor)* ... 235.



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- ■ Spreadsheet Analyst 2.5 ..... 99.
- ◙ Think Tank 2.41NP ..... 135.

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- ■ ClickArt Business Images ..... 42.
- ■ EPS (PostScript) Illustrations ..... 79.

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- ◙ XTREE Pro 1.1 ..... 69.

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- TOPS 2.0 ..... 119.
- TOPS Repeater *(extends network)* ..... 132.

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- ◙ LapLink Plus 2.1 ..... 85.
- ◙ ViewLink 1.0 *(first product to link all your existing software programs and data)* .... 95.
- ◙ DeskLink 2.21 ..... 99.

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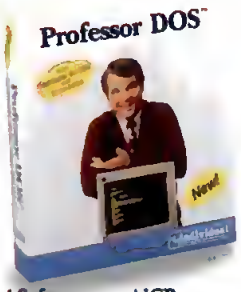
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☐True BASIC 2.1 *(now includes Runtime)* . . . 57.
⊞3-D Grephics . . . . . 45.
Vericomp ... NCP
⊞SoftBytes 2.0 . . . . . 35.
WordPerfect Corp. ... NCP
⊞WordPerfect Library 2.0 . . . . . 69.
⊞WordPerfect Executive . . . . . 129.
☐WordPerfect 5.0 . . . . . 239.
⊞WordPerfect Office 2.0 . . . . . 269.
⊞WordPerfect Network 5.0 . . . . . 349.
⊞Additonal Network Stations 5.0 . . . . . 84.
Wordtech ... NCP
☐DBXL 1.2 . . . . . 119.
Xerox ... NCP
☐Ventura Publisher 2.0 . . . . . call
XYQUEST ... NCP
☐XyWrite III Plus 3.54 w/A-le-Certe Menus . 229.

RECREATIONAL/EDUCATIONAL

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⊞Hardball *(baseball simulation)* . . . . . 11.
⊞Testdrive *(driving simulation)* . . . . . 22.
⊞Jack Nicklaus' 18 Greatest Holes. . . . . 29.
⊞Grand Prix. . . . . 22.
Barron's ... CP
⊞SAT *(Test preparation program)* . . . . . 35.
Broderbund ... CP
⊞Where in the World is Carmen Sandiego? . 25.
⊞Where in the USA is Cermen Sandiego? . . 25.
⊞Where in Europe is Cermen Sendiego? . . . 29.
☐JetFighter *(by Velocity)*. . . . . 35.
Electronic Arts ... CP *(reqs. graphics brd.)*
⊞Chessmaster 2100. . . . . 35.
⊞Life end Death *(from Software Toolworks)*. . 35.
⊞Chuck Yeager's Flight Treiner 2 . . . . . 35.
☐688 Attack Sub . . . . . 35.
☐Megic Candle . . . . . 35.
Microprose ... CP
☐F-19 Stealth Fighter *(requires CGA or EGA)* 39.
☐F-15 Strike Eegle *(raquires CGA)* . . . . . 22.
Microsoft ... NCP
☐Flight Simulator 3.0 *(reqs. graphics brd.)* . . 35.
Mindscape ... CP
☐Geuntlet . . . . . $29.
⊞Paperboy . . . . . 29.
☐Colony 1.0. . . . . 30.
⊞Balence of Power 1990 . . . . . 30.
Parlor Software ... CP
☐Bridge Parlor 2.3. . . . . 49.
Sierra On-Line ... CP
(All require Hercules, CGA or EGA)
⊞Leisure Suit Larry II . . . . . 33.
⊞King's Quest IV *(512k version)* . . . . . 33.
⊞Manhunter . . . . . 33.
⊞Police Quest II . . . . . 33.
⊞Space Quest II. . . . . 33.
⊞Gold Rush. . . . . 25.
Spectrum Holobyte ... NCP
⊞Tetris *(eddicting mind teeser)* . . . . . 24.
⊞Falcon/AT *(F-16 simulation, reqs. graph. brd.)* 32.
Stone & Assoc. ... NCP *(reqs. graph. brd.)*
⊞Memory Master *(eges 2 to 8)* . . . . . 22.
⊞My Letters, Numbers, Words *(2 to 6)* . . . . . 22.
☐2nd Math *(eges 7 to 16)*. . . . . 27.



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☐Up Periscope. . . . . 25.
True BASIC, Inc. ... NCP
⊞Kemeny/Kurtz Meth Series . . . . . 32.
XOR ... NCP
☐NFL Challenge 2.0 . . . . . 89.

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Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

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I/O Mini 2 C/S/P. . . . . 89.
SixPekPlus 64k C/S/P *(upgrades to 576k)* 129.
Advantage Premium 512k S/P . . . . . 429.
RAMpege Plus 286 512k *(for XT286/AT)*. . 539.
RAMpege Plus MicroChannel 512k . . . . . 539.
Compucable ... 2 years
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3-Position switch box. . . . . 39.
Cuesta ... 1 year
Detasaver 400 Watt
(standby power backup) . . . . . 459.
Curtis ... lifetime
Curtis Clip CC-1. . . . . 8.
Disk Holder DB-1 *(holds 50 5¼" disks)* . . . . 8.
3½" Disk Holder DB-2 *(holds up 40 disks)* . 8.
Printer Stand PS-1 . . . . . 18.
Universal System Stand SS-3. . . . . 25.
Smartmodem-to-PC Cable EC-7 *(9 feet)*. . . 17.
Printer-to-IBM cable EC-6 *(9 feet)*. . . . . 17.
Filtered SafeStrip SPF-3 . . . . . 21.
Emerald SP-2 . . . . . 36.
Ruby SPF-2
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Ruby-Plus SPF-2 Plus
(w/FAX & modem protection) . . . . . 89.
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LQ-500 *(80 col., 180 cps, 24 pin)*. . . . . 295.
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LQ-950 printer *(110 col., 264 cps, 24 pin)* . call
LQ-1050 printer *(136 col., 400 cps, 24 pin)* call
LQ-2550 printer *(136 col., 400 cps, 24 pin)* call
LX-800 printer *(80 col., 180 cps, 9 pin)*. . . 179.
Printer-to-IBM cable *(6 feet)* . . . . . 15.
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For FX-850, LX-800, LQ-850, LQ-500 . each 7.
For the LQ-950 . . . . . 10.
For FX-1050, LQ-1050, LQ-2550 . . . . each 12.
Everex ... 1 year
1200 Baud Internal Modem. . . . . 79.
2400 Baud Internal Modem. . . . . 149.
5th Generation ... 1 year
Logical Connection 512k. . . . . 529.
Logical Connection 1 Meg. . . . . 749.



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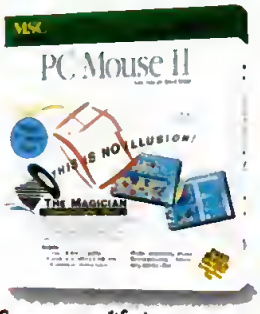
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Grephics Card Plus ..... 189.
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2400B Modem 2 *(internal modem for PS/2 Models 50/60/80)* ..... 269.
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8087-2 *(8 MHz, for PS/2 Models 25 & 30)* 139.
80287 *(for AT & XT286)* ..... 149.
80287-8 *(for 8 MHz 80286 machines)*.... 219.
80287-10 *(for PS/2 Models 50 & 60)*..... 259.
80387SX *(for 80386SX machines)*..... 359.
80387 *(for 16 MHz PS/2 Model 80)*..... 399.
80387-20 *(for 20 MHz PS/2 Model 80)*... 459.
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Masterpiece ..... 94.
Masterpiece Plus..... 109.
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PowerTree 20 *(surge protection and filter)*.. 29.
PowerTree 50 *(surge/filter/modem prot.)*... 52.



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Logitech ... lifetime
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New HiREZ Mouse *(bus or serial)*..... 89.
Mouse w/Paint Show *(bus or seriel)* ..... 95.
ClaerCase Mouse *(seriel only)* ..... 99.
ScanMan *(hend hald scanner)* ..... 219.
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Microsoft ... 2 years
Mach 20 *(1 yr. wrty.)*..... 349.
Mach 20 Disk Plus Option *(floppy controller)* ..... 69.
Mach 20 Memory Plus Option *(512k upgradeable to 3.5 Meg)*..... 339.
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Mouse with Easy CAD *(bus or seriel)* .... 125.
Mouse with Windows 286 2.1 ..... 139.
Mouse Systems ... lifetime
OmniMouse *(serial only; 1 year warranty)*.. 49.
PC Mouse II w/PC Paint+ *(bus or serial)*... 89.
PC Mouse II w/Autosketch *(bus or serial)* . 105.
NEC ... 2 years
Multisync 2A *(VGA Monitor)*..... 499.
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Silancer 200 *(69% noise reduction)*..... 149.
Turbo Cool 375 ..... 299.
PC Support Group ... 1 year
Breakthrough 286-12 *(12MHz eccelerator board)* ..... 449.
Breakthrough 286-8 *(8MHz eccelerator board)* ..... 299.
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1200 Baud Extarnal Modem *(mini)*..... 79.
P/Link *(extends par. print signal)*..... 109.
Microbuffer Inline *(par. print buffer/32k)* 135.
2400 Baud Intarnel Modem..... 159.
2400 Baud External Modem ..... 179.
2400 Baud Internal Modem for PS/2 .... 229.
Princeton Graphics ... 1 year
Max15 Monochrome Monitor ..... 269.
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Safe Power Systems ... 2 years
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Safe 425W *(standby power backup)*..... 369.
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Targua ... lifetime
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Leathar Laptop carrying case ..... 129.
TheComplete PC ... 2 years
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TheComplete Hend Scanner 200 *(half-pg)* 169.
TheCompleta Answering Machine..... 239.
TheComplete FAX 4800 ..... 279.
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you'll also be able to schedule in minutes, weeks, and months. Second, the program doesn't allow a start-to-finish dependency relationship.

With activities and their relationships entered you can process the project's schedule. *Promis* took longer to do this than any other program except *Plantrac*. It also finished below average at resource-leveling speed.

THREE GRAPHIC VIEWS A project's schedule can be seen in a tabular format or in three graphic views: a Gantt chart, a network diagram and a time-scaled network diagram. *Promis* uses only the precedence method for its network diagram. While its screen graphics are designed well, *Promis* uses poor color combinations—in one configuration, bright cyan backgrounds with bright pink lines. Only the time-scaled network allows you to change color combinations on the fly. The next version of *Promis* will extend this capability to all the graphs.

Resources are the next major concern in creating a project. In addition to the ID and description, you specify the unit measure, such as man-hours, in a ten-character field. If you use a unit measure that doesn't represent a full day, then filling in the availability level requires some arithmetic on your part. For example, if you use man-hours you have to multiply the number of resource people available on a daily basis by the number of working hours in a standard day. You can specify both a standard and overtime cost rate for each resource. Overtime or profit factors can be calculated from a percentage entered on the resource form.

When it comes to assigning resources to an activity, you can be very precise about when a resource is needed. You do this by entering the first day it has to be on the job and how many days it's needed. You can split up your resource allocation if, for instance, you want some resource to be available for the first 2 days of a 10-day activity and also for the last 3 days. Each time you assign a resource you indicate whether it's using the standard or overtime cost rate. The system makes resource assignment quite flexible.

Resources can drive the scheduling of an activity automatically if you choose this option as a default for the project. Then, if a resource need exceeds the duration of the activity, the program will change the duration to suit the resource assignment. As an alternative to the automatic schedule change, you can have *Promis* prompt you for a change in duration. This lets you say no to the suggestion and instead increase the availability of the resource.

In effect, resource-driven duration is resource-limited scheduling at the basic level of an individual activity. True resource leveling and limiting has to take into account activities that share resources. *Promis* tries to level within the available float. If it can't, it pushes the early project dates as far as necessary. This gives you two schedules, a resource-constrained early schedule and your original late schedule, resulting in a project with negative float. To get your project back on track you have to reprocess the network—changing the late dates to reflect the resource constraints—or juggle resource availabilities and activity durations. Resource leveling is a very slow process in *Promis* because you can work on only five resources at a time.

The other side of resources is costs. In addition to generating expense reports based on the way resources are allocated, *Promis* lets you assign as many overhead costs to an activity as you want. Because these costs have their own ID and description, it's easy to pull them out later for reports.

UPDATE CONTROL *Promis* gives you excellent control in updating a project. Activities, resources, and costs are split off into separate progress screens so that progress in one won't necessarily indicate progress in the others. This pliancy lets you reflect how the real world works. On the Activity Progress screen you enter the actual start date and then indicate actual finish, early finish, remaining duration, or percent complete. If you're in automatic mode, filling in one of these fields generates the others. If you're in manual mode, percent complete is not automatically calculated. This divorces that field from reflecting time alone. Now you can use it to represent resource use, the amount of work in place, or actual costs.

■ *Promis* splits off activities, resources, and costs into separate progress screens so that progress in one won't indicate progress in the others.

Updating a project is just part of the tracking phase. You also have to produce progress reports. *Promis* has a fairly wide selection of reports, but it doesn't allow you to change or customize them. All you can do is sort and select fields, and some fields may not even be available in some reports. SSP has an add-on report writer called *Intelligent Report System*, but it costs $795. With it you can customize reports and create new ones.

Promis lets you model a project well and update it thoroughly. It suffers from an interface that forces you to take too many steps between functions, and the standard

PC MAGAZINE FACT FILE



SSP's Promis
Strategic Software Planning Corp.
One Athenaeum St.
Riverview II, 15th fl.
Cambridge, MA 02142
(617) 577-8800
List Price: $2,995
Requires: 640K RAM, hard disk, DOS 2.0 or later
In Short: *SSP's Promis* is a function-key-driven program. There is ample coding on activities, and resource assignments can be split. *Promis* offers a time-scaled network diagram on the screen. The program is slow—especially at resource leveling, and you can level only five resources at once. Reporting is also weak unless you buy an add-on package. Copy protected with a hardware key.

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CIRCLE 329 ON READER SERVICE CARD

Autoschedule

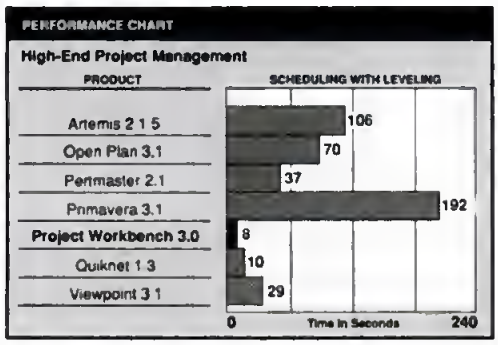
New Products	Day	Resrc	July 1989: 26	3	10	17	24	31
MARKET ANALYSIS				H				
Plan Analysis								
Define Objectives	6	JD	C·····	··	·	·	·	
Arrange Resourc								
Conduct Intervie								
Interview Corp								
Interview Opera								·····
Interview Marketing	6	LA	·	·	·	·	·····	
Consolidate Findings	10	LA TB	·	·	·	·	·	CL·
Utilization								
John Davis	4.0v	JD	4.9	4.3	2.1	1.8	1.0	
Tom Benson	5.0v	TB	0.5	2.6	4.5	3.4	2.4	
Larry Ashton	5.0v	LA		1.0	3.9	4.1	6.1	
Total days			5.4	7.9	10.5	9.3	9.5	

Scope Group of projects
Backup before Autoschedule? Yes
Include resource constraints? Yes

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CIRCLE 339 ON READER SERVICE CARD

package is missing some desirable elements. If you like the strict order that *Promis* imposes on projects, however, you may want to give it a try.

ViewPoint

Working in *ViewPoint* is like working with colored electronic building blocks. You create projects on-screen by laying down blocks of varying length, representing activity durations. Red blocks or bars are critical tasks, and blue ones are noncritical. By indicating precise links, you tie tasks together to show the flow of work. Activity blocks can be slid around the screen, put off to the side for later use, or simply thrown away. Directly manipulating blocks gives you a physical sense of your project. It also makes building projects a logical, structured process. In addition to its excellent graphical scheduling, *ViewPoint* is extremely fast. It is capable of handling enormous projects efficiently, and it does a fine job of posting progress on your project.

As powerful as the program is, you don't have to be a programmer to use it. *ViewPoint* makes active use of pop-up menus and forms. Other entries can be made by pointing at pop-up lists. A mouse makes it extremely easy to maneuver through the program and issue commands.

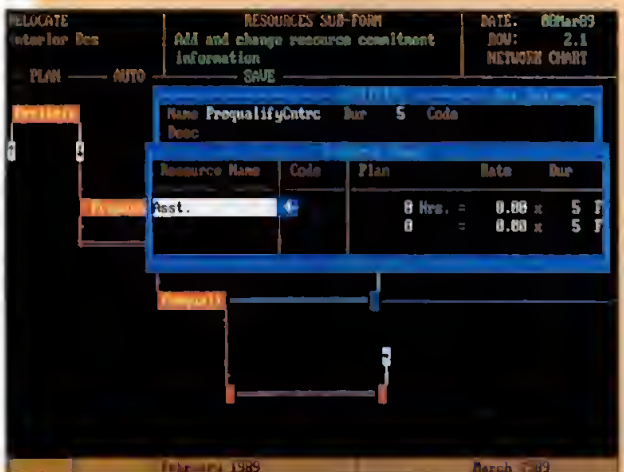
EDITOR'S CHOICE

PC MAGAZINE FACT FILE



ViewPoint
Computer Aided Management Inc.
1318 Redwood Way, #210
Petaluma, CA 94952
(707) 795-4100
List Price: $1,995; *ViewPoint Graphics*, $995.
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: *ViewPoint* is an extremely well-rounded program, giving you good control over scheduling, progress, and reporting. It encourages a structured approach to planning, with WBS levels playing a prominent role. The program is the fastest we reviewed in both scheduling and resource leveling. Not copy protected.

CIRCLE 407 ON READER SERVICE CARD



The main Project Planning screen in ViewPoint *is o time-scaled network diogram. In this screen you can see the activity time bars partly overlaid by pop-up octivity ond resource usage boxes. The arrow next to the resource name indicotes that o list of choices can be colled up on the screen. The little block arrows going to and from the Prelimin octivity bar indicate that there is another project level below this one.*

The central work area in *ViewPoint* is the Planning screen. This is where you construct a time-scaled network chart of your project. *ViewPoint* is the only program that offers such a chart on-screen. It shows the flow of a project from activity to activity, graphically revealing the existing dependencies among project elements, and it shows this happening against the backdrop of time.

To position activities or events, you maneuver a cursor that looks like a blinking cross hair. Where you place the cursor defines the starting date of the event or activity. The time scale that runs along the bottom of the screen can be expanded or contracted to let you see anywhere from 1 week to about 6½ years at once. Version 3.0 permits planning down to the day; not being able to plan activities by the hour or minute is one of the program's minor weaknesses. Computer Aided Management is planning an upgrade for *ViewPoint* in the fall. The new version will have microscheduling and will add several other features.

POP-UP FORMS You add an activity or event to a project by filling in a form that pops up when you fix its position by pointing—that is, by pressing the gray Plus key, or the left button on a mouse. Unfortunately, *ViewPoint* assumes that all activities are of the ASAP (as soon as possible) type. You can't assign ALAP (as late as possible) activities. The activity form has one code field, but because it allows for 16 characters you can subdivide the entry into a number of codes, each with a name, starting location and length for use in summarization, sorting, and selecting. On the activity form, you also enter one line of description and assign one of ten user-definable calendars. Individual calendars are assigned by activity rather than by resource, as they are in some other programs.

After you've put the building blocks of the project on the Planning screen, you have to assign dependencies. This is also a very physical process. If you want to indicate a start-to-start dependency between two activities, you put the cursor at the beginning of the first activity bar and press a key, then move to the beginning part of the second activity bar and press the key again. Up pops a connection form that spells out the connection you've just marked and gives you the opportunity to enter a lag time. You can't set a negative lag, but this will be allowed in the next major release of the program.

The current version of *ViewPoint* (Version 3.0) has made quite a turnaround when it comes to speed. Earlier versions were fairly slow, but now the program recalculates a schedule of 200 activities in just a few seconds, making it faster than any other high-end program we reviewed.

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PC MAGAZINE

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CIRCLE 207 ON READER SERVICE CARD

PC MAGAZINE EDITOR'S CHOICE

- **Open Plan**
- **ViewPoint**

Two programs stand out above the others: ViewPoint *and* Open Plan. ViewPoint *has an excellent graphical interface. You build a project interactively in a time-scaled network diagram, so you get to see when activities occur and how they relate to each other, all at once. If you use a mouse, creating a schedule is fast and easy. The program is engineered to facilitate top-down planning, so you can build your schedule at different levels—each level summarizing those beneath it. Each project has the capacity for up to 65,000 activities, and the activities can be resource-driven, which means their duration is controlled by the resources allocated to them.*

Open Plan *is the most expensive program, but it also has the greatest power and flexibility, due in part to its use of* dBASE III Plus *or* FoxBASE Plus. *The program offers both a standard menu- and form-based interface and a graphical interface. The graphical interface lets you interactively build a network diagram using the keyboard or a mouse.* Open Plan *allows for 10,000 activities per project, and it is moderately fast at scheduling and resource leveling. There is an outstanding complement of standard reports and a full-fledged report writer. The on-screen graphics and plotter output are quite attractive. Our enthusiasm is somewhat tempered by the need for one of two database programs, the difficulty in customizing advanced features, and the high price. It's well worth overcoming these drawbacks, however, and if you already use* dBASE *or* FoxBASE, *choosing this program makes a lot of sense.*

ViewPoint facilitates structured project planning by allowing you to schedule on levels. Indeed, the program is specifically designed for the top-down method of planning. This means that you define an overview of your project, working from the highest level of summary down to the nitty-gritty of individual activities. Building a project schedule this way helps simplify the task, makes connections among phases and tasks easy to see, provides natural levels of visibility for top-level and functional management, and shows how resources and costs are to be aggregated.

NETWORK TREE You create project sublevels by adding lower-level boxes to the network tree, which is reached with the F5 key. The network tree, essentially a work-breakdown structure, functions like a doorway to the planning screens of the lower project levels. A project can be broken down into as many levels as you need. All resource utilization and cost data are summarized from the bottom up. Levels and sublevels can be used to manage multiple projects and ensure that shared resources are leveled across all the projects.

To make this structured approach to planning easier, *ViewPoint* lets you reuse activities by saving them to a library. This is wonderful for large projects with many repetitive tasks. You can also save resources, budget codes, and calendars to a library.

The resources for a project are defined on a tabular screen, reached through the Project Specs option on the main menu. Resource assignment is fairly traditional and straightforward. You can assign a code to each resource used to classify resources for reporting purposes. Each resource can have an unlimited number of billing rates tied to different dates.

Resources are entered into activities by pointing at the Resources command on the

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border of the activity form. Up pops the resource form with the resource's name and its planned cost according to the rate and duration of the activity.

ViewPoint's physical approach to project planning is evident again when it comes to resource histograms and leveling. Resource use or costs can be displayed on a histogram. As you move the cursor across the vertical bars of the profile, you get to see the exact data and the level of commitment or cost. If you place the cursor on the peak of a bar and press Alt-F, you can see which activities are causing the peak.

Normal resource leveling, which is done at the Profile screen, reduces the level of demand for a resource by shifting the schedule of noncritical activities within their available float. If you look at the Gantt chart, you can see the activities that were changed, because they blink and have a quotation mark in front of them.

Another form of leveling is constraining the resource or cost expenditure. You draw a beaded line across the profile at the level you want to establish as the maximum (it can be a steplike series of levels), and *ViewPoint* will reschedule activities to fit the constraint. In this case, even critical activities will be shifted, changing the finish date of the project. An Undo command lets you remove all leveling or constraining actions, so "what if" analysis is quite simple. *ViewPoint* is also the fastest resource-leveling high-end program.

Tracking a project's progress with *ViewPoint* is simple. By pointing to the word Plan in the upper-left corner of the Planning screen, you toggle to Track mode. Now, by pointing to an activity, you can update the resource usage—if it's resource-driven—or update its duration. To enter progress on resource usage you can record the percent complete, the actual work done, or the work remaining. When entering the remaining work, you can develop a complex scenario for how it will be accomplished—one amount of work on some days and a different amount on another set of days.

Another feature that makes tracking a project easy is Snapshot. It allows you to record the original baseline plan before any progress is entered. Then, as you post progress, the Performance Gantt Display will show the baseline as a light blue line above the actual activity bars. When you're done entering progress and a new schedule has been calculated, activities that are behind schedule will have an outlined bar to the left of the activity bar representing the original baseline.

STANDARD REPORTS *ViewPoint* offers 15 standard tabular reports. You can edit these reports to include only the activities or resources you want, using selection criteria on various fields. Reports can be sorted to your liking, and each can have a unique heading. You can also create custom reports, writing definitions for them with a word processor and the *ViewPoint* report command language. A report generator reads and processes these.

■ *ViewPoint*'s graphical interface, speed, and structured approach make it an excellent high-end choice.

In addition to all the features in *ViewPoint*, Computer Aided Management offers a graphics program that gives you the ability to produce presentation-quality Gantt and PERT charts, as well as a work breakdown structure and time-scaled network charts. It costs an additional $995 and supports dot matrix printers, lasers, and pen plotters. The next version of *ViewPoint* will allow for the import and export of project files in ASCII, *dBASE* and *Lotus 1-2-3* file formats (this ability was in beta testing at the time of review).

ViewPoint is an excellent high-end choice. It offers the ability to control massive projects combined with the ease of use more typically found in low-end programs. Its graphical interface, speed, and structured approach to projects set it apart. PC

Henry Fersko-Weiss is a frequent contributor to PC Magazine.

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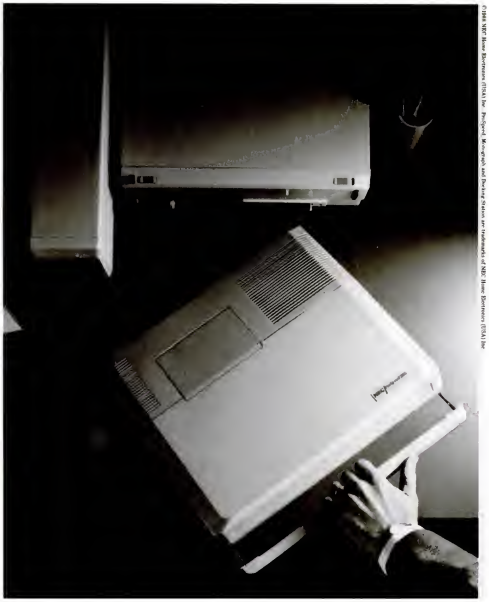
As you'd expect from a powerful 386 desktop, it runs at a swift 16MHz, has seven expansion slots and up to four drives. So it can handle anything you throw its way.

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TRAINING *on* TAP



Should video and audio courses have a place in your training plans? Our evaluation of eight desktop publishing tutorials will help you decide.

EIGHT DESKTOP PUBLISHING TAPES

PageMaker and *Ventura Publisher* are simply full of features and functionality: they get better with each new release. And they're the two most popular entries in a field that Dataquest, the San Jose–based market research firm, predicts will quadruple in sales between 1988 and 1992. However, neither package is easy to learn to use. And the concepts of desktop publishing design itself are hardly intuitive.

The growing popularity of a complex software category such as desktop publishing packages is increasing the training burden on businesses that want their employees to effectively use the packages. Unfortunately, good personal training, consisting of one-on-one instruction with a knowledgeable teacher who can answer questions and tailor the course to what the user needs most, is costly and hard to find. And classroom courses, though easier to manage, usually offer little accommodation to individual needs and vary widely in quality.

In response, many corporations, universities, and other organizations are turning to video- and audiotape courses in an attempt to stretch their training dollars. The average cost of a tape, about $250, is comparable with the cost of sending just one student to a single course at a training center. But the tape can be used for many students, and brush-up training or review comes at no extra charge. Especially when you compare it with the even higher cost of hiring an application consultant to train on-

Photograph: James Porto

Desktop Publishing Training Tapes: Summary of Features

(Products listed in ascending price order by group)

	Ventura Publisher			
	How to Use Xerox Ventura Publisher $195	Learn Xerox Ventura Publisher, Basic to Intermediate $195	The Desktop Professor $295	Publishing with Venture, Version 2.0 $298
Tapes included (time per tape)	5 audiocassettes (90 min.)	1 videotape (90 min.)	2 videotapes (75 min.)	6 audiocassettes (45 min.), 1 videotape (30 min.)
Applicable DTP software	*Ventura Publisher* 1.1	*Ventura Publisher* 1.1	*Ventura Publisher* 1.1 and 2.0	*Ventura Publisher* 1.1 and 2.0
Scope	Basic to advanced application skills	Basic to intermediate application skills	Basic to advanced application skills	Basic to advanced application skills
Course indexed to tape counter	●	○	○	○
On-screen counter	N/A	●	○	○
Documentation	111 pages	50 pages	130 pages	205 pages
Sample files	●	●	●	○
Accessories	Quick reference guide	Typographer's ruler	None	Quick reference guide, typographer's ruler

PC—Editor's Choice ●—Yes ○—No N/A—Not applicable: this package has no video component.

site, the reusable medium begins to look very attractive. Here we look at eight desktop publishing training tapes: two for *PageMaker*, Version 3.0, four for *Ventura Publisher*, and two designed to explain the concepts of desktop publishing.

WHY TRAINING? Of course, not all aficionados of desktop publishing software believe you have to put users through a training regime in order for them to use DTP packages effectively. *Ventura Publisher* has an outstanding tutorial that comes with its documentation. The *PageMaker* manuals also do a decent job of getting you started with the program. In fact, many of the courses we review here are based on the tutorials included with the documentation. So why should you spend good money for an extra course?

The answer depends upon individual preferences. Some people are not satisfied with written documentation alone, and that's why they pay additional dollars to attend classes, hire on-site training, or watch videos that lead them through the lessons. Unlike workbooks, video and audio courses can push you through the lessons at a steady pace, providing a little extra structure for those who are less than perfectly self-disciplined. At the same time, if you need to go back over a topic, you can simply rewind the tape.

Video and audio training courses offer other potential advantages over personal or classroom training. They can be used either for study by individuals or for group training. When being trained by tape, students can proceed at their own pace, and the lessons can be arranged to suit their schedules. Such courses are consistent, communicating the same information in the same terminology to each student who uses it. Finally, a tape doesn't get sick, and it will never cancel a class on you.

■ *Ventura Publisher* comes with an outstanding tutorial; *PageMaker* also does a decent job getting you started.

Video courses can reinforce their points by showing you how something works. Many aspects of graphical systems such as desktop publishing programs are most easily understood if they are demonstrated visually. A good example is the use of the mouse—it may seem obvious once you've been shown how, but many would-be users need help taking that first step. Explanations of dynamic events, such as laying out graphics while snaking text around them, also benefit from the extra time dimension that video provides. Special effects such as zooms and dissolves can help focus your attention on details and make multistep explanations more lively and interesting.

Moreover, video and audio courses often go well beyond the scope of the manufacturer's tutorial. Freed from the obligation to address all possible users, these courses can focus on a more specialized audience—for example, corporate desktop publishing managers. Many of the courses we review offer undocumented tips and techniques in their workbooks, and the more professionally oriented ones are treasure troves of real-world advice on topics

	PageMaker		Graphic Design	
Learn Xerox Venture Publisher, Advanced **$395**	**How to Use PageMaker** **$195**	**Learn PageMaker 3.0** **$395**	**Introduction to Design for Desktop Publishing** **$295**	**PC Learn Graphic Design** **$1,295 (2 volumes)**
1 videotape (105 min.)	6 audiocassettes (90 min.)	1 videotape (90 min.)	8 audiocassettes (90 min.)	3 videotapes (120 min.)
Ventura Publisher 1.1	*PageMaker* 3.0	*PageMaker* 3.0	No specific software	No specific software
Advanced application and management skills	Basic to advanced application skills	Basic application skills	Design, typography, and production skills	Design, typography, and production skills
○	●	●	●	○
●	N/A	●	N/A	○
96 pages	125 pages	40 pages	260 pages	40 pages plus 2 reference texts (460 pages)
●	○	○	●	○
Typographer's ruler	Quick reference guide	Typographer's ruler	Color charts, paper guide, typographer's ruler	Typographer's ruler

such as style-sheet management, document planning, and integrating DTP into the organization.

TAKE YOUR PICK Are video and audio training systems worthwhile investments for you? How do you determine the best one to suit your particular training needs?

First of all, pick a course that suits your goals. If you plan to use your desktop publishing program to produce large books or corporate reports, your time won't be well spent with a course that concentrates on graphic design issues. Similarly, if obtaining layout skills is your goal, don't get a tape geared to turning you into a book or magazine publisher.

Most of these courses take the newsletter as a common ground, using it to demonstrate both simple and complex points. Typically, they consist of video and/or audio cassettes, an accompanying workbook, and a floppy disk with sample files used in the exercises. Most of them assume you are a novice at desktop publishing, but a few are geared solely to high-level instruction. Some offer DOS tutorials, but true neophytes who have never touched a computer should get a grounding in the basics of the PC before starting one of these courses.

The *Ventura Publisher* courses are meatier on the whole than the *PageMaker* courses, primarily because *Ventura Publisher* itself is more complex and offers more sophisticated features. Even if you understand the basics of *Ventura*, you might benefit from a taped course's explanations of such arcana as index and table of contents generation, kerning, and font management. Experienced users can take advantage of a taped course to brush up on the new features of *Ventura*'s latest, Version 2.0, which differs in significant ways from Version 1.1. At least one tape (*Publishing with Ventura*) makes a point of noting these differences when they arise and explaining how to make use of them.

■ Most of these courses take the newsletter as a common ground, using it to demonstrate simple, as well as complex, points.

The tapes geared toward the concepts of desktop publishing outline the basic skills of graphic design, including layout, type selection and placement, and the effective use of graphics. They will not teach you how to use any particular desktop publishing program. In fact, they barely mention computers. Their only purpose is to give you the conceptual background that you need to create clean, attractive, effective documents—knowledge that you should not underestimate. Desktop publishing programs are powerful tools in the right hands, but they don't guarantee good results—you do.

DIFFERENT STROKES Of equal importance in your decision should be the type of instructional method you prefer. Will people learn as individuals, or in group sessions? Are enough computers available for each person to have one?

Many of the courses assume that you'll sit at your computer and do the lessons step by step with the tape. Others are more flex-

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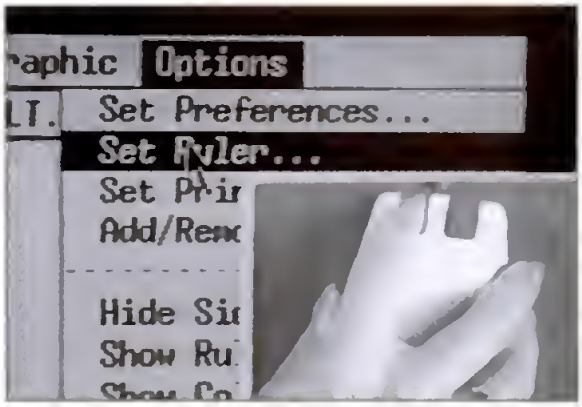
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■ DESKTOP PUBLISHING TRAINING TAPES

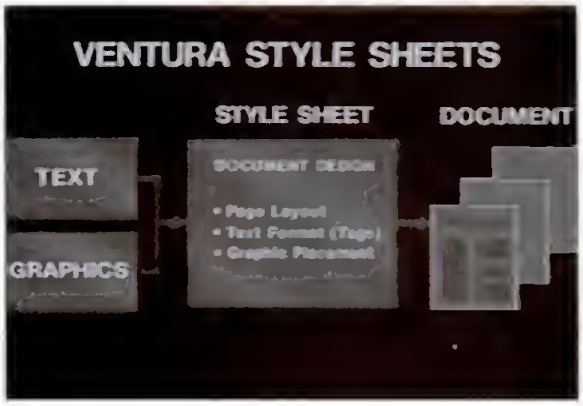
Video courses take advantage of the medium in different ways to make their message more interesting. From technically tricky sequences that focus your attention on simple details to practical demonstrations of complex actions, a video potentially offers a richer educational experience than you can get from an audio only course or a training book alone. But courses vary in terms of quality; some are created far more imaginatively than others. We've captured one image from each of the video packages we reviewed to give you an idea how they stack up. (Although all of these video training tapes are in color, we're reproducing them in black and white.)



It's important for o desktop publisher to learn mouse/eye coordination; The Desktop Professor *from ABCIS uses special effects to show you what's supposed to happen when you move it.*



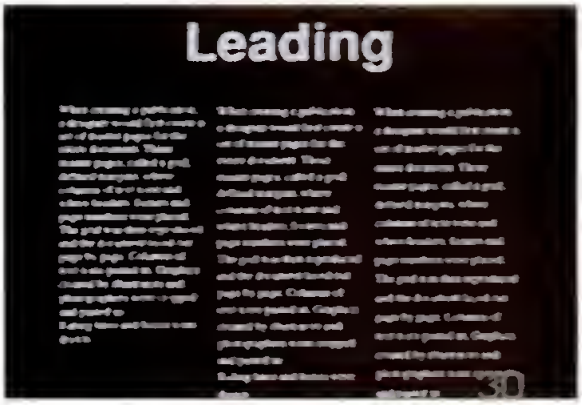
VideoTutor's Learn Xerox Ventura Publisher, Advanced *trades off between the narrator, Jan White, and staged scenarios that illustrate and emphasize important points.*



Publishing with Ventura *uses a special effect for better visual emphasis: an evolving graph shows you the steps of creating and using a style sheet.*



In Learn Graphic Design, *the lecturer, takes you on as his apprentice for 6 hours. When he shifts from theory to practice, he moves from his design table to a classroom.*



Learn PageMaker 3.0 *takes advantage of simulation to focus your attention on the topic at hond. Here, the impact of leading is shown in slow motion, so it's easier to see.*

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On the other hand, Bitstream scaleable type can offer any size you want from 2 point to 144 point. Giving you hundreds more type sizes for about the same price as one printer cartridge. Moreover, you get the larger sizes that are so important for presentations and headlines. Bitstream also offers 5 times as many typefaces to choose from. And unlike cartridges, you can mix and match faces without any limits. Finally, Bitstream scaleable type works with all the leading laser printers, including Hewlett-Packard® and PostScript® PDL printers. Maybe that's why the leading makers of word processing and desktop publishing packages offer Bitstream® typefaces with their products, too. For the name of the Bitstream dealer nearest you, call **1-800-522-FONT.** You'll see that cartridges just don't size up to Bitstream scaleable type.



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ible, allowing you to do the lessons away from the tape or even away from the computer.

The video-based courses have the advantage of being able to show you what should happen when you do something. But you may prefer an audio course for individual instruction because you can't watch a video and do an exercise on the computer at the same time without losing your place.

■ You should pay attention to the production quality of a tape: if trainees are bored to tears by it, the lessons won't stick.

The better courses take advantage of the strengths of their media and avoid their weaknesses. For example, the video courses from VideoTutor use the video to give an introduction to the lesson, but leave the step-by-step exercises to the workbook. Training Specialties' *Publishing with Ventura*, an audio course, has a video introduction to the mouse and the *Ventura* user interface; this eases your transition to the rest of the course.

Finally, you should pay attention to the production quality of the course. If trainees are bored to tears by a tape, its lessons will fail to stick. But at the same time, remember that a tape's purpose is not to entertain at the cost of losing the real message. Most tapes are produced professionally, using actors, but some, especially those produced by newer vendors on smaller budgets, are hosted by in-house talent. The narrators' styles vary widely. Some are thoughtful and intriguing; others may induce a laugh attack.

If you're unsure about a tape's value, don't forget your local school or public library. Often you can rent a video course, check it out for home viewing, or view it at the library. If you work in a large corporation, check with your in-house training department; the company may already have one or more of these tapes available. If you decide to buy a course, you'll probably have to order it. Though a few video courses are beginning to be found on software dealers' and booksellers' shelves, most are sold only direct from the manufacturer.

WORTH A LOOK Can prerecorded training abolish the role of a human instructor? Definitely not. Video and audio courses have inevitable drawbacks, and there will always be a need for the kind of customized training that only a knowledgeable consultant can provide. But these courses are far better than their predecessors, which were justifiably maligned for their poor production values and content. Today, there's no reason why some aspects of the training process can't be delivered in a canned format.

In fact, these tapes may work best when used in conjunction with a tailored training course. By letting the tape cover the fundamentals, instructors can save their own time for project-oriented training, answering students' questions, covering fine points, and going into more depth on topics of particular interest.

Remember that time is money. If 2 focused hours with a good teacher can take the place of 6 hours with tapes, the teacher is the better deal. But for disseminating a large amount of information to a large number of people, these training tapes are worth a look.

Tami D. Peterson is the owner of Decorum Corp., a New York–based desktop publishing consulting firm. She is a frequent contributor to PC Magazine.

VENTURA PUBLISHER

The Desktop Professor

The Desktop Professor, from American Business Computer Information Systems (ABCIS), is geared toward teaching *Ventura Publisher* to new users of the program. The $295 videotape-based training package's slick use of special effects helps the learning process along in some clever ways.

For example, to help you get acquainted with the mouse, the video projects a small picture of it in the lower-right-hand corner of your screen, showing you the movements that execute the function under discussion. This kind of viewer involvement is unique to this course. Other special effects, such as zoom shots and graphic overlays, are used appropriately and are especially beneficial in the explanation of tiny details like kerning, ruler placement, and line spacing.

■ *The Desktop Professor* isn't the only package to take *Ventura Publisher*'s own outstanding training guide as its starting point.

The Desktop Professor includes two 75-minute tapes, a disk of sample files, and a student guide. The first seven lessons mirror the ones you find in *Ventura Publisher*'s own tutorial. The remaining lessons are found in the ABCIS student guide and are keyed to the sample files. We reviewed the course for *Ventura Publisher*, Version 1.1, but an updated course for Version 2.0 should be available by the time you read this.

A VALUABLE SUPPLEMENT This is not the only package to take *Ventura Publisher*'s own outstanding training guide as its starting point. However, it offers enough additional material to provide a valuable supplement. The video highlights the importance of DOS knowledge and gives good advice on hard disk management. And it faithfully directs you where to look in the *Ventura* tutorial or the ABCIS workbook to get further information on various topics.

The final lessons cover some of *Ventu-*



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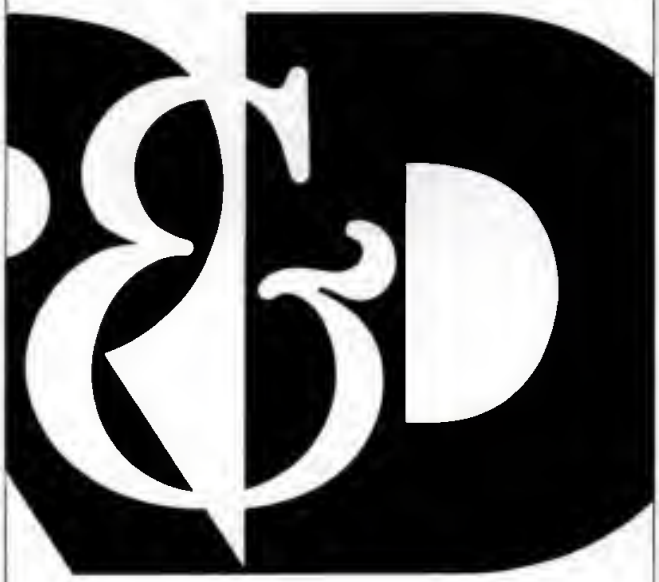
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■ DESKTOP PUBLISHING

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

The Desktop Professor
American Business Computer Information Systems
20770 Orchard Lake Rd.
Farmington Hills, MI 48024
(313) 547-3300
List Price: $295
Requires: Videotape player, television monitor, PC with *Ventura Publisher* installed.
In Short: This concise and well-produced video course for *Ventura Publisher* makes exceptionally good use of special effects to get its points across. While covering the basics well, it presents enough advanced features and unpublished tips to make it useful to advanced Ventura users as well as beginners.

CIRCLE 550 ON READER SERVICE CARD

ra's more-advanced features exceptionally well. For instance, the course manages to address one of *Ventura*'s most complicated features, indexing, in such an elementary manner that its logic is readily apparent. After viewing this lesson, almost any student can grasp the essence of the indexing operation well enough to perform it immediately. Table of contents generation is also covered thoroughly and clearly.

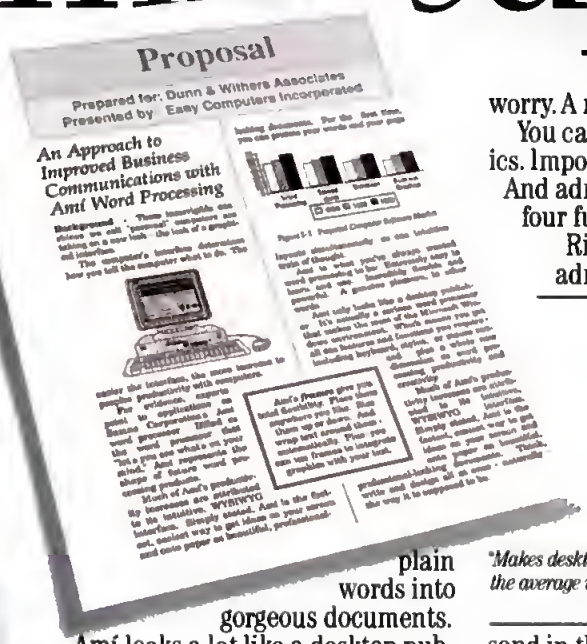
The Desktop Professor is the only video course in the roundup that relies on you to set the tape counter to zero before beginning each tape. At the end of each lesson, you must note the counter number to pick up the next lesson at the appropriate place. While slightly time-consuming, this method is not really an imposition, and it's worth the extra effort to avoid the distracting on-screen tape counter found in other videos.

When you finish the course, ABCIS will mail you an official Certificate of Completion. Though hanging it on your wall won't really impress your friends and coworkers, your valuable new skill with *Ventura Publisher* might.

How to Use Xerox Ventura Publisher

How to Use Xerox Ventura Publisher, from FlipTrack Learning Systems, is an audio training package that employs a patented technique linking general training in-

Look great without a lot of makeup.



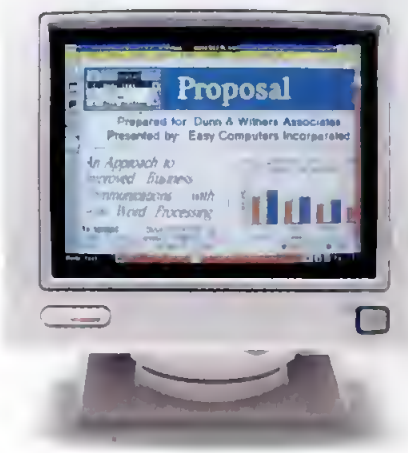
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PC/Computing

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Michael J. Miller, in InfoWorld

"Makes desktop publishing class output a snap for the average user."
William Zachmann, in PC Week

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GEM Artline By CCP

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CIRCLE 743 ON READER SERVICE CARD

■ DESKTOP PUBLISHING TRAINING TAPES

PC MAGAZINE FACT FILE

How to Use Xerox Ventura Publisher
FlipTrack Learning Systems
999 Main St., Dept. 98
Glen Ellyn, IL 60137
(800) 222-FLIP (outside Ill.)
(312) 790-1117
List Price: $195
Requires: Audiocassette player with digital tape counter, PC with *Ventura Publisher* installed.
In Short: This audio training system is best-suited to the student who prefers a highly structured training environment. The course content is progressive, so you can start as a beginner and gain advanced skills over time.
CIRCLE 601 ON READER SERVICE CARD

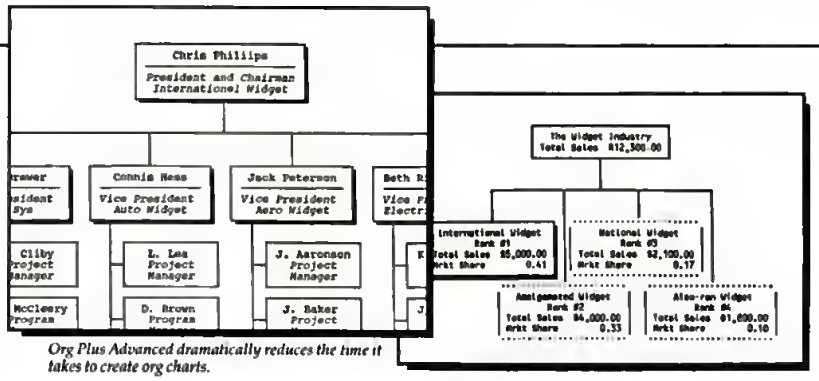
struction on one side of the tape to more-detailed, help-oriented instruction on the other side.

To use this system, you sit in front of the PC and follow the narrator's instructions on an audiotape. Then, when you reach a topic that requires more discussion or that is best demonstrated on the computer, the narrator invites you to join him on the "FlipTrack side." (A shrill beep alerts you to the upcoming FlipTrack message.) If you think you can benefit from the additional information, you stop the tape, flip it over, reset the tape counter to zero, and play the FlipTrack lesson. When the explanation is over, you rewind the tape to zero, turn it back over, and press play to continue the training.

A FULL HOUSE FlipTrack's *Ventura* course is thorough, designed to take a *Ventura* beginner all the way to an advanced level of knowledge. It is thus comparable to two or three classroom training sessions—a good buy at $195. The package comes with five 90-minute cassettes, a floppy disk with sample files, and a 100-page workbook.

The workbook examples are comprehensive, well written, and fully illustrated. They are filled with helpful hints, such as how to simulate a square bullet through custom ruler manipulation. Acquiring this kind of typically undocumented information can do a lot to stimulate your creativity and it can also help you to gain control of the program more quickly.

The FlipTrack courses are definitely less flexible than most of the other packages, because you must sit in front of the computer and do the lessons as they are discussed. The constant tape flipping can become something of a distraction, too. Of course, flipping a tape is not a big technical challenge, but a student sitting down to learn a complicated piece of software for



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CIRCLE 496 ON READER SERVICE CARD

the first time may feel the computer is enough hardware to manage.

If you don't mind this type of lockstep regime, however, *How to Use Xerox Ventura Publisher* is an excellent bargain. It doesn't have fancy graphics, but it does offer a wealth of useful information at a reasonable price.

Learn Xerox Ventura Publisher, Basic to Intermediate
Learn Xerox Ventura Publisher, Advanced

VideoTutor's series on *Ventura Publisher* includes two separate courses. *Learn Xerox Ventura Publisher, Basic to Intermediate*, retailing at $195, is a 90-minute video introduction to the program for beginning desktop publishers. It covers the basic *Ventura* skills and a few of the program's more-advanced features, such as indexing, figure and table counters, and table of contents generation.

Learn Xerox Ventura Publisher, Advanced, a 105-minute videotape retailing for $395, is geared toward the professional desktop publishing operations found in many major corporations. It highlights such important factors as style-sheet management, document planning, and project scheduling.

All of VideoTutor's training courses use a "watch and then do" training approach, which works well for both individual and group training. In this technique, each video segment ends by instructing the viewer to turn to the workbook and computer to complete the training exercise before advancing to the next lesson. This is preferable to requiring you to follow the video while working at the computer; if you have to concentrate on the computer screen and video screen at the same time, you tend to fall behind and will fail to benefit fully from the video training. Another advantage: the PC and the VCR do not have to be in the same place.

Both courses come with a workbook and a floppy disk of sample files; the advanced course throws in a typographer's ruler.

PROFESSIONAL ADVICE John Meyer, the president of Ventura Software, lends credibility to *Learn Xerox Ventura Publisher* by furnishing the introduction and conclusion to the course. The video and accompanying workbook are segmented into nine exercises, beginning with "The Basics," which covers the *Ventura* screen interface and, more importantly, teaches the user how to develop "mouse-eye" coordination. You'll then proceed to the hands-on lessons, in which you create and complete a demonstration newsletter. The course amply demonstrates *Ventura*'s versatility, highlighting both its graphic design and advanced document processing features.

Learn Xerox Ventura Publisher, Advanced is narrated by Jan White, a graphical design educator and typographical communication specialist. The video trades time between White's lectures, on such subjects as bringing desktop publishing into an organization for the first time, and hands-on training exercises. Although White is outspoken in his opinions on design and layout issues, the information he delivers is accurate, and many of his suggestions are worth heeding.

If you simply want to learn more about *Ventura Publisher*, you can skip over White's advice and go straight to the application lessons, an excellent source for harnessing the full power of the program. The course covers every advanced feature, from autonumbering (an elaborate outlining structure) to indexing and other multi-

■ All of VideoTutor's training courses use a "watch and then do" approach, which works well for both individual and group training.

chapter options. It also offers detailed explanations of font-width tables, the addition of new fonts, and the program's merge features—invaluable to those who use *Ventura* heavily.

Thanks to VideoTutor's well-orchestrated effort to explain basic skills, *Learn Xerox Ventura Publisher* is one of the best training systems for the *Ventura* novice. The detailed visual exercises and patient presentation on this tape provide just the kind of support that inexperienced desktop publishers need. *Learn Xerox Ventura Publisher, Advanced* goes beyond the competition into the program's most advanced features. Production supervisors, office managers, department executives and others responsible for internal documents will find much to learn from White's wise professional insights.

Publishing with Ventura, Version 2.0

Training Specialties Inc. (TSI), the maker of *Publishing with Ventura*, Version 2.0, offers many alternatives in one package. This $298 course includes both audio and video components and can be used while working with *Ventura* or the accompanying workbook, as well as by themselves. Travelers and commuters will especially

PC MAGAZINE FACT FILE

Learn Xerox Ventura Publisher, Basic to Intermediate
Learn Xerox Ventura Publisher, Advanced
VideoTutor
110 Wild Basin Rd., #280
Austin, TX 78746
(800) 252-1225
(512) 328-3721
List Price: $195 (basic), $295 (advanced).
Requires: Videotape player, television monitor, PC with *Ventura Publisher* installed.
In Short: A patient manner and an emphasis on the absolute basics make the first part of this two-product series the best choice for the true beginner at *Ventura Publisher*. The advanced course is a must for those in the process of bringing desktop publishing into a large corporation. It goes well beyond the program itself to address design principles and management issues such as the planning of publications.

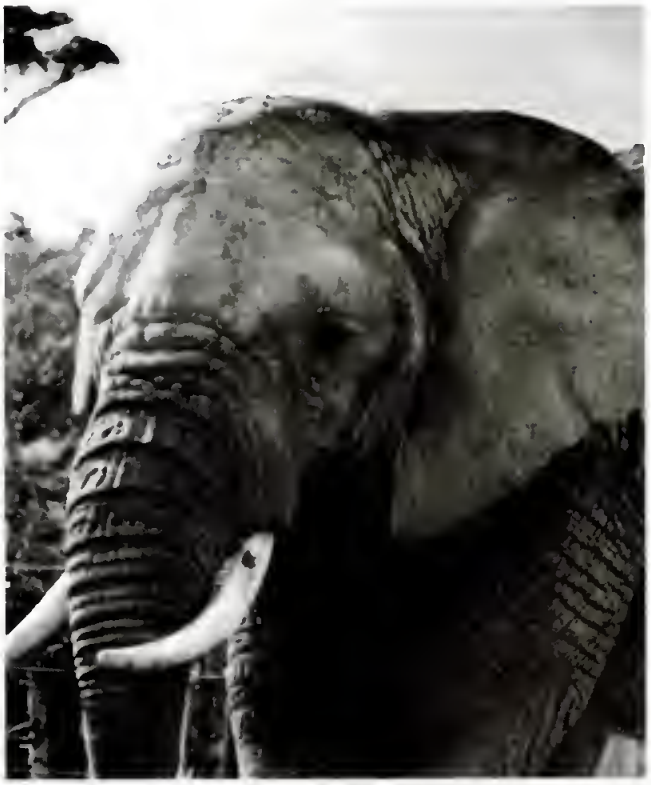
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appreciate this flexibility, because you can continue to learn even while you're not near a PC.

Like most *Ventura* training packages, the learning tools in *Publishing with Ventura* borrow from the exercises provided in *Ventura*'s accompanying training and reference guide. But TSI effectively supplements the *Ventura* exercises with its own brand of training techniques. In so doing, it has produced an evolutionary training program suited for everyone—from individual users to corporate training instructors to sales and technical personnel who will support *Ventura*.

The package is uniquely well organized in its methodology, focusing at all times on the bottom line of how *Ventura* can help you to be more productive in your work. Each technique explained in the lessons is preceded by a statement of the benefits you can gain from mastering it, and each lesson concludes with a summary that puts the exercise in perspective for you. Throughout the course, the lessons emphasize the value of document planning, reinforcing this principle through tangible examples.

VIDEO INTRODUCTION The *Publishing with Ventura* package includes a 30-minute introductory videotape, six double-sided audiocassettes, an instructional workbook, and a quick reference card. The videotape is an excellent idea, a humanizing introduction to the meat of the course. A well-spoken narrator introduces the training material and the features of *Ventura*. She explains which audiocassettes to begin with, depending upon your current skill level, and effectively demonstrates the program's user interface, the use of the mouse, and the relationship between the operational modes and the functions you need to perform. To finish, she demonstrates the potential of the package by completing a custom document from scratch.

■ Though most of the training material is on audiocassettes, *Publishing with Ventura* includes a 30-minute introductory videotape.

Once you're on track, there is no specific order in which you must use this courseware—your level of skill and your time constraints govern your path of progression. Intermediate and advanced users may find it beneficial to review the various sections before choosing a starting place. Beginners, on the other hand, are best off starting with the first tape and then proceeding to select one of the other training options.

Publishing with Ventura does a good job covering the new features of *Ventura Publisher*, Version 2.0. The last audiotape is devoted entirely to the differences between Version 1.1 and Version 2.0, so experienced 1.1 users can get up to speed on 2.0's new features without taking the whole course. Throughout the lessons, the workbook highlights the upgraded version with illustrations of its new pop-up and help menus; one chapter even lists the enhancements by category for easier reference.

TSI purposely does not include a diskette with the tapes, but you can get one at no extra charge by mailing an enclosed card. The sample files include all the document-planning forms used in the workbook. TSI also offers a separate 1-hour tape and a 20-page documentation package for *Ventura Publisher: Professional Extension*. When purchased separately, the package retails for $98, but owners of *Publishing with Ventura* can purchase it for a discounted price of $49.95.

Publishing with Ventura is the best of the audio courses, a progressive learning program that is flexible enough to satisfy the needs of new, intermediate, and advanced users. It contains enough information to turn the beginner into a skilled *Ventura Publisher* user in a surprisingly short period of time.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

***Publishing with Ventura*, Version 2.0**
Training Specialties Inc.
P.O. Box 5000
Solana Beach, CA 92075
(619) 481-4858
List Price: $298; tape for *Ventura Publisher: Professional Extension*, $98 ($49.95 for course owners).
Requires: Videotape player, television monitor, audiocassette player, PC with *Ventura Publisher* installed.
In Short: Alternatives abound in this multimedia training package, which you can use with or without the software itself. It is especially notable for addressing the new features of *Ventura Publisher, Version 2.0*, and so makes a good choice for those upgrading from Version 1.1. It is also the only course to offer materials on *Ventura Publisher: Professional Extension*.

CIRCLE 603 ON READER SERVICE CARD

PAGEMAKER

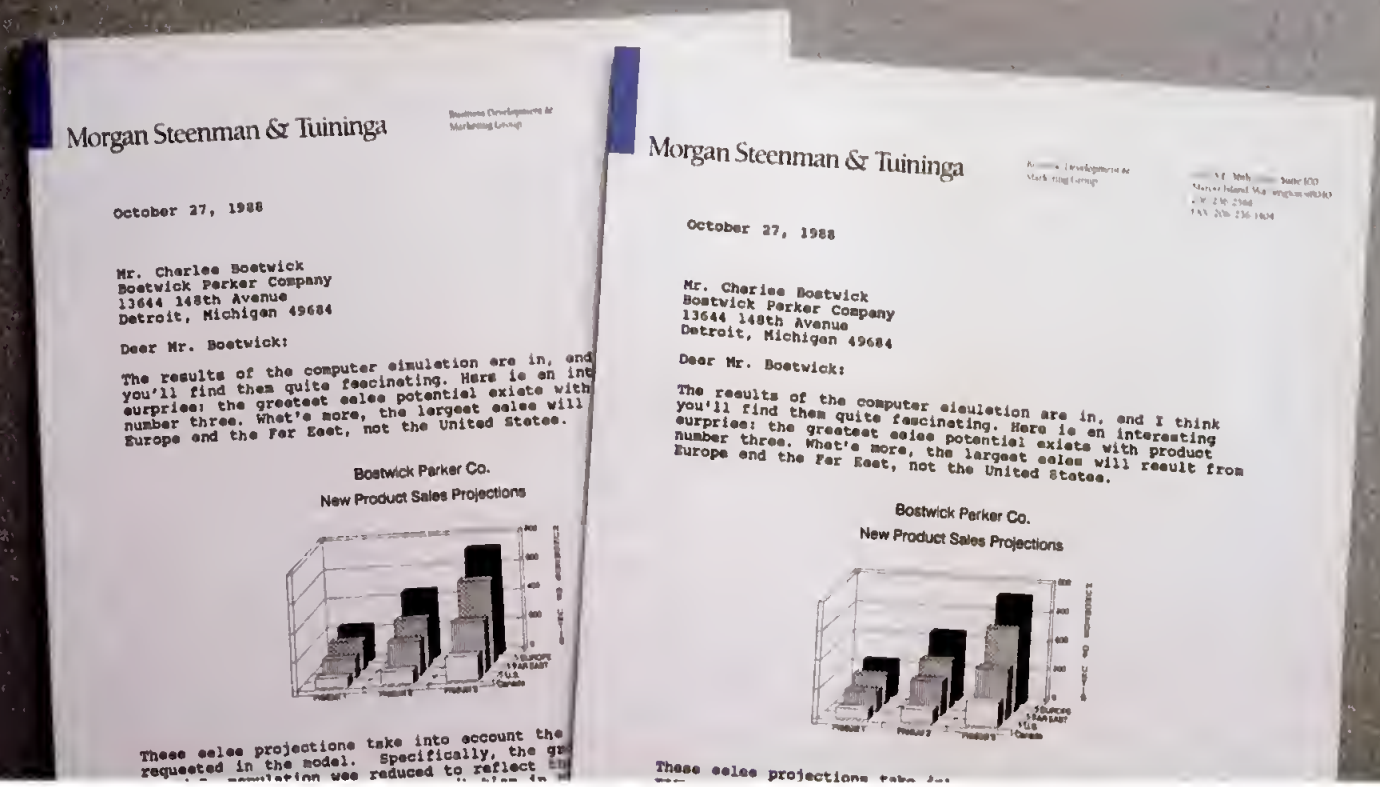
How to Use PageMaker

FlipTrack Learning Systems brings its patented audio training technique to *PageMaker* in the PC version of *How to Use PageMaker*. Like the company's *Ventura Publisher* course, it is quite a bargain, with six audio tapes, a 125-page student guide,

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How to Use PageMaker
FlipTrack Learning Systems
999 Main St., Dept. 98
Glen Ellyn, IL 60137
(800) 222-FLIP (outside Ill.)
(312) 790-1117
List Price: $195
Requires: Audiocassette player with digital tape counter, PC with Aldus Corp.'s *PageMaker* 3.0 installed.
In Short: If you prefer an audio training system, *How to Use PageMaker* is a good buy. It starts with the very basics of your computer and *Microsoft Windows* for beginners, while intermediate or advanced users can learn new operations without wading through the basic material. The examples include a variety of office documents, not just newsletters, making it an attractive choice for corporate users.

CIRCLE 548 ON READER SERVICE CARD



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MT905 Specifications

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- Resolution: 300 x 300 dpi.
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- Standard I/Os: Serial & parallel.
- Memory: 512K. [upgrades: 1, 2, & 4 megabytes.]
- Typefaces: Courier medium & bold, line printer, accepts standard HP font cartridges or any downloadable font in HP-format, 6-resident fonts + 2 font cartridge slots.
- Paper Handling: 250-sheet input & output bins. Manual feed handles single sheets, envelopes, transparencies, and labels.
- Workload: 4,000 pages-per-month.
- Suggested Retail: $1,995.

For more convenient paper handling, the universal paper cassette holds letter, legal, and international sizes, plus up to 15 standard envelopes. You can choose face-down output to keep long documents in the right order. And the manual feed lets you print labels or transparencies.

So any way you figure, the answer still comes up the same. The Mannesmann Tally laser looks perfect. And so does the price.

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CIRCLE 726 ON READER SERVICE CARD

and a sample diskette filled with files used for each of the six comprehensive lessons, all for $195.

As with other FlipTrack training courses, you use an audiotape player with a digital counter to follow the lessons, flipping the tapes over at your discretion when the narrator indicates that there is further information on the flip side. This allows students of varying skill levels to use the same set of training materials, since more-advanced students can skip the extra FlipTrack opportunities.

■ FlipTrack training courses provide further information about topics they cover on the flip-side of each audio tape; you can flip the tape over at your discretion.

This course is noteworthy in that its exercises include charts, price lists, brochures, catalogs, and other typical business documents—it doesn't just use the standard newsletter. This should be especially attractive to corporate users and others who will be using *PageMaker* for general-purpose desktop publishing, as well as for those who will be working with longer, book-length documents. The workbook contains samples of each type of document you are asked to produce in the lessons, for easy comparison with your own efforts.

KNOW YOUR BUSINESS *How to Use PageMaker* begins at the beginning of the *PageMaker* program, but it does assume you already know the basics of typography. If points and picas are foreign to you, you should become familiar with them before starting. The course includes no glossary of typographical terms in the workbook.

Although the introduction states that you should be aware of the basics of DOS, the first tape provides quite a bit of detail for those without such knowledge. Several FlipTrack lessons are devoted to learning such basics as creating, removing, and changing subdirectories. The DOS TREE and PATH commands are also discussed.

The introduction also recommends that you use a PostScript printer, since the lessons use a variety of different fonts. But if you have a Hewlett-Packard LaserJet, the narrator will instruct you on how to locate the fonts available on your printer and how to substitute the most appropriate ones for the lessons. However, as with most training tapes, this one gives you no assistance in actually installing your *PageMaker* or special fonts.

Because *PageMaker* operates in the *Microsoft Windows* environment, the initial lesson starts the course off by showing you how to use the mouse and *Windows*. Though *Windows* neophytes may appreciate the narrator's forced surprise when he says, "hmmm . . . another dialog box" each time one appears, anyone experienced with *Windows* will grimace until this has ceased.

Many comic-book expressions like ZAP!, WAM!, and PRESTO! occur in response to something happening on your screen, to keep things lively. Another monotony-reducing technique is the role-swapping that occurs between the two narrators, one male and one female. While one is playing instructor, the other assumes the role of FlipTrack presenter.

How to Use PageMaker is a well-rounded training program for would-be *PageMaker* users at all levels. Its content is ample, offering enough substance to suit those with some acquaintance with *PageMaker*, while filling in the gaps for beginning users with the flip-side discussions of the basics.

Learn PageMaker 3.0

Learn PageMaker 3.0 is designed for beginners. The $395 video training package is concise and direct, sticking to the basics and offering few of the "tricks" that delight experienced desktop publishers.

Like all the application training courses from VideoTutor, this course follows a standard format, which the company calls a "video-based closed-loop learning system." This method does not require a computer to be in the same room with the video equipment. Rather, you watch the example for a particular lesson, then complete the corresponding exercise in the workbook at the computer, using example files included on a diskette for each lesson. Since you do not have to be at the computer while you're watching the video, the tape can move at a faster pace, so the format is more flexible and less mundane than most training systems.

■ VideoTutor's courses don't require a computer to be in the room with the video equipment; you watch the example, then do the computer lesson.

The video offers a personalized introduction to the course and how it works. Beginners are acquainted with the mouse and the *Microsoft Windows* interface. From there, the course follows the production of a newsletter, complete with columns of varying width, wrap-around text, a few lines set with tabs, and images that must be sized and cropped. Style sheets, new to *PageMaker*, Version 3.0, are used to customize the document formatting, and a template is constructed to demonstrate how you can reuse layouts for repetitive publications.

Though its focus is on the needs of novices, this package does offer a supplement to some workbook lessons (called a "workshop"), where you can find helpful hints to improve the efficiency of your work. The most useful of these tells you how to format your word processor documents before importing them into *PageMaker*.

The video examples were filmed on a large-screen monitor, which lets you see the entire publication on-screen as it is being worked on. The majority of the lessons

PC MAGAZINE FACT FILE

***Learn PageMaker* 3.0**
VideoTutor
110 Wild Basin Rd., #280
Austin, TX 78746
(800) 252-1225
(512) 328-3271
List Price: $395; upgrade for current owners of VideoTutor's *PageMaker* 2.0 course, $200.
Requires: Videotape player, television monitor, PC with Aldus Corp.'s *PageMaker* 3.0 installed.
In Short: This beginner's guide is the best course for new users of *PageMaker*. Experienced *PageMaker* users, however, will have to look elsewhere to improve their skills.
CIRCLE 549 ON READER SERVICE CARD

were filmed on a monochrome monitor, except for the last lesson, in which a high-resolution color monitor is used to demonstrate *PageMaker*'s spot-color feature. Unfortunately, the workbook lesson states that you need a color monitor to do this exercise, making it seem as though *PageMaker*'s spot-color feature works only in color—which is not the case.

Learn PageMaker 3.0 is the latest release from VideoTutor, updated for the enhancements found in Version 3.0. The training program shows significant improvement over the company's release for Version 2.0.

GRAPHIC DESIGN

Introduction to Design for Desktop Publishing

Like its application training tapes, FlipTrack Learning Systems's *Introduction to Design for Desktop Publishing* uses one side of an audiocassette for general lessons and the flip side to offer detail and reiteration. Unlike them, however, the $295 course does not require a computer in order to be valuable. Without the computer to tie a student down, FlipTrack's step-by-step, turn-the-tape-over process seems less restricting.

Introduction to Design for Desktop Publishing teaches the fundamentals of graphic design and applies them to real-world situations. Not only do you learn how to choose type and set moods with color and layout, but you also learn how to select a print shop, get estimates, plan a budget, and track advertising insertion schedules. For $295, the program covers more information relating to copywriting,



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California

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■ DESKTOP PUBLISHING TRAINING TAPES

PC MAGAZINE

EDITOR'S CHOICE

- **The Desktop Professor**
- **Publishing with Ventura, Version 2.0**
- **Learn Graphic Design**

Few of these products compete directly on all levels. The audio courses, which offer depth in place of visual excitement, tend to be best for self-paced, individual instruction. Some video courses also wark well for this purpose, but most of them excel in the group setting, either as a starter to hands-on exercises, or as preparation for one-on-one sessions with an instructor. And the graphical design tapes caver a completely different set of skills from those designed to teach you how to use a specific DTP package. Accordingly, our Editor's Choices represent our picks in three categories—video courses, audio courses, and graphical design tapes.

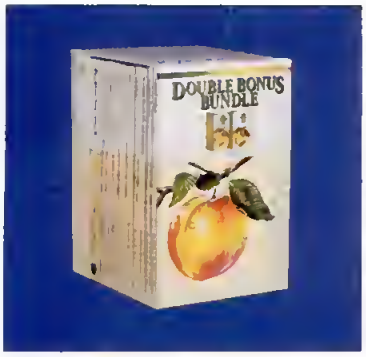
Among the video courses, The Desktop Professor *for* Ventura Publisher *stands out from the competition for the quality of its production and the depth of its course material. Taking excellent advantage of the possibilities of the video medium, it gives the beginner a sound introduction to the mouse and to the graphic environment, making adroit use of special effects that make students feel as though they're accomplishing samething as they watch. The course maves fram the basics to an advanced level in a smooth progression, and it covers* Ventura's *more-camplex features with exceptional clarity and logic.*

Good use af video also makes the difference in the audio category. The introductory videotape in Training Specialties' Publishing with Ventura, *Version 2.0 offers a lot af substance in just half an haur. It covers mouse skills, the* GEM *enviranment, priuter basics, and the general terms of desktop publishing and gives you a jumping-off point for the rest of the course. The narrator projects a comfortable personality, adding the essential element of personal involvement. The audio course that follows is flexible yet thorough, covering all the features of the program and many additional tips in its six tapes and workbook.* Publishing with Ventura *is notable far its full coverage of the new features of* Ventura, *Version 2.0, and it is the only caurse that covers* Ventura Publisher: Professional Extension *(albeit at extra cost).*

The graphical design tapes must be judged mast af all by the quality af the infarmatian they pravide. By this standard, Learn Graphic Design *fram VideaTutar is by far the most professional in content. Though it is a good deal more expensive than anything else in its category, this 6-hour seminar on the secrets of successful graphic design can be of imneasurable beuefit to those who rely on the printed page. It is aimed squarely at people with little or no design training who find themselves in the positian af managing graphical design projects. This typifies the majarity af desktap publishing users. The quality of the tape and its accompanying books is top-notch, and it is sure to influence the standard by which other graphical design training materials will be measured.*

Remember, none of these courses can replace a personal instructor. You should take your time as well as yaur pocketbook into account before you purchase a prerecarded tape.

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CIRCLE 494 ON READER SERVICE CARD

■ DESKTOP PUBLISHING TRAINING TAPES

advertising concepts, and production management than you can get from a two-semester college communications course.

The excellent 260-page workbook contains e series of exercises to be used in conjunction with the instructions on eight audiocassettes. Numerous sample charts and forms are included, and you can experiment with the ones provided or create your own as you work your way through the design lessons. The package includes color charts on both matte and glossy paper, emphasizing the difference that paper quality can make in the final product. Paper samples in various finishes and weights, and a typesetter's point and leading gauge complete the set of tools.

Since this course does not focus on any particular desktop publishing program, you won't learn how to go about using your newfound knowledge on your own system. But you will face less confusion about type and design when you do sit down for the first time with *PageMaker* or *Ventura Publisher*.

PC MAGAZINE FACT FILE

Introduction to Design for Desktop Publishing
FlipTrack Learning Systems
999 Main St., Dept. 98
Glen Ellyn, IL 60137
(800) 222-FLIP (outside Ill.)
(312) 790-1117
List Price: $295
Requires: Audiocassette player with digital tape counter.
In Short: Highly professional in its content, this course is recommended for students with no prior design skills who are learning the concepts of desktop publishing for the first time.

CIRCLE 604 ON READER SERVICE CARD

Learn Graphic Design

Though this video-based training course's title is simple, its content is comprehensive. Narrated by Jan V. White, an expert on typographical communication and graphic design, this course emphasizes simplicity. The $1,295, two-volume video set is a condensed version of a two-day seminar White conducts, in which he reveals the secrets of successful communication through thoughtful presentation of text and graphics.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Learn Graphic Design
VideoTutor
110 Wild Basin Rd., #280
Austin, TX 78746
(800) 525-1225
(512) 328-3721
List Price: Two-volume set, $695 each volume, $1,295 for set.
Requires: Videotape player, television monitor.
In Short: Directed at professionals in publishing, this comprehensive course reveals the secrets of designing printed material so as to captivate readers' attention. Jan White, a well-known expert in the field, lends strong credibility and interest to the course.

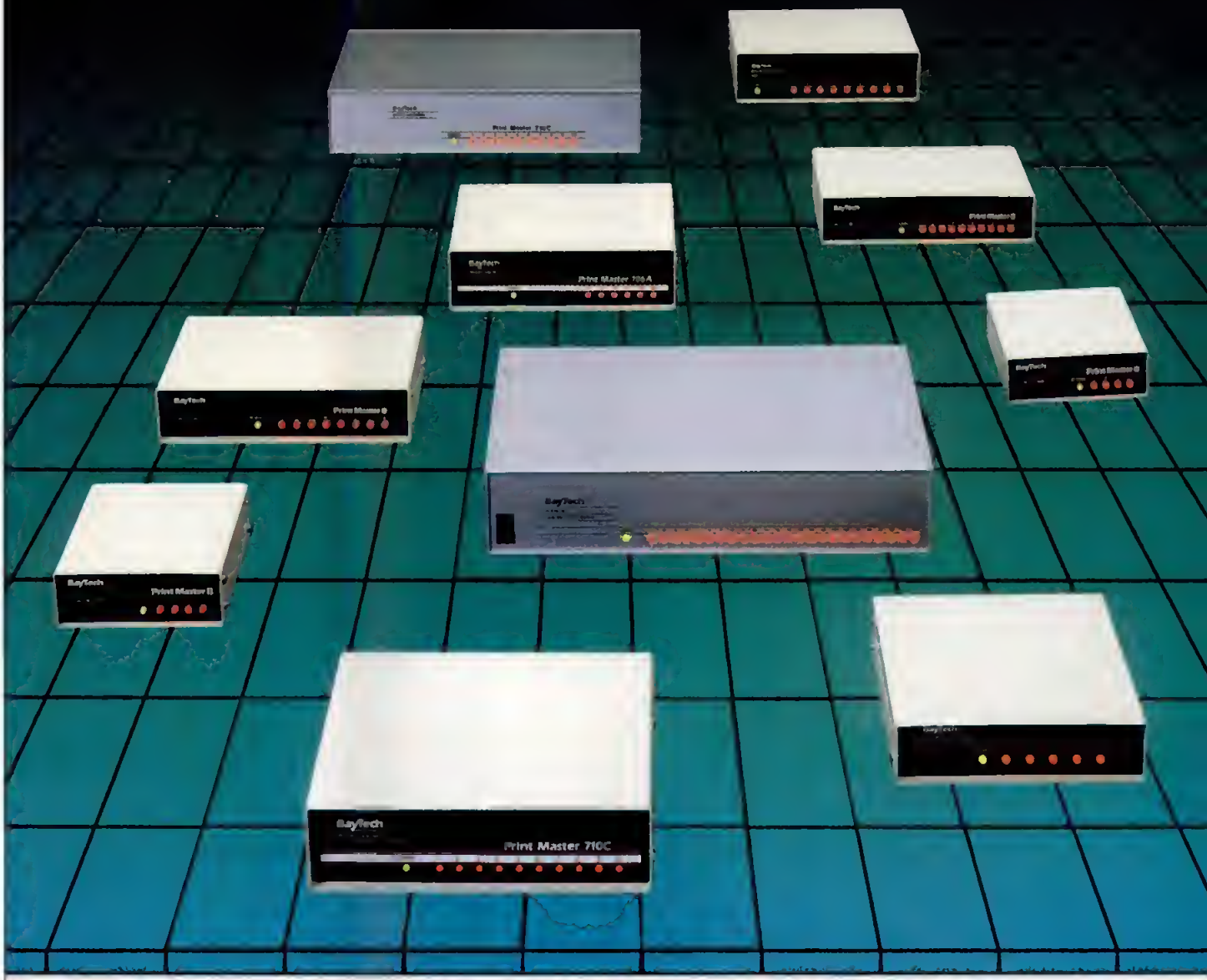
CIRCLE 605 ON READER SERVICE CARD

The first volume is a two-tape course based on White's book *Editing by Design*. Taped in his Connecticut studio, the course covers every step in the publication process. Most valuably, you'll learn how to unlearn many "rules" left over from high school and college days. Because it attempts to help them unlearn bad habits, this course is valuable to the practicing professional as it is to those with no previous design training.

The second volume, containing one videotape and the book *Graphic Design for the Electronic Age*, applies White's design principles to electronic production methods. The course is intended for anyone involved with magazine, book, or newsletter production, not just for desktop publishers. In fact, the tape's discussions of which chart types are best for presenting various kinds of data should be mandatory viewing for business and financial professionals who use spreadsheets and graphics packages.

The tapes are of excellent viewing quality. Special effects, like the electronic chalkboard style used in television football replays, are effectively used to pinpoint information on the screen as the examples are discussed. Although the volumes can be acquired separately for $695 each, you will want both volumes to *Learn Graphic Design* thoroughly.

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CIRCLE 172 ON READER SERVICE CARD



We Interrupt T War For This Im

To all those unlucky enough to be stuck smack in the middle of the current spreadsheet confusion, take heart.

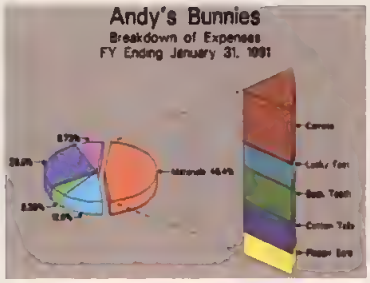
There is, at last, a viable alternative to war: revolution.

One that delivers even more performance than you have (ahem) been waiting for, but without demanding expensive new hardware or extensive retraining. And without abruptly cutting you off from any user in your company, even those on mainframes.

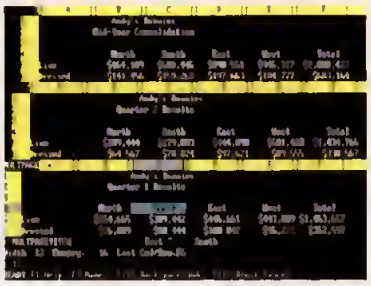
The name of the spreadsheet is SuperCalc® 5.

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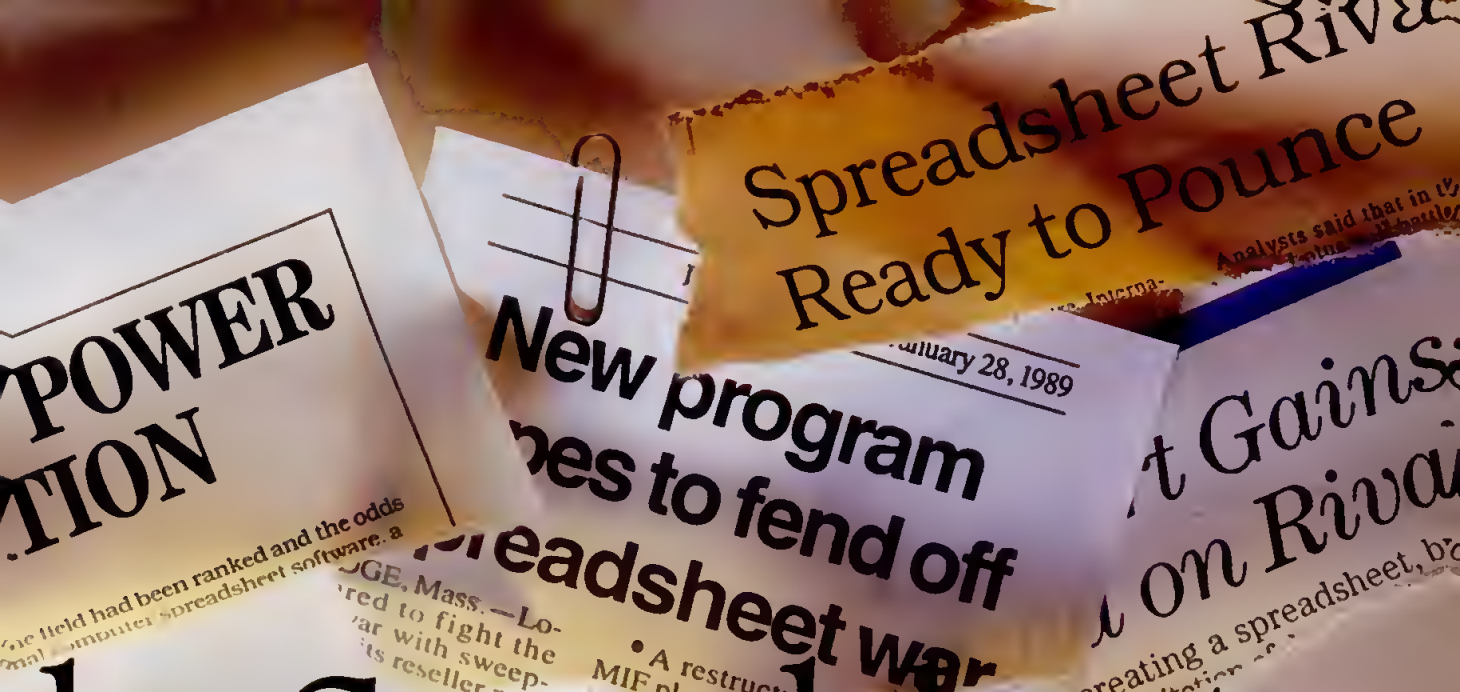
Plus, SuperCalc5 actually makes productivity easier. An integrated Undo feature simply reverses unwanted commands. And a truly comprehensive system of debugging highlights costly errors and analyzes macro logic.

Perhaps even more impressive is the way SuperCalc5 can link spreadsheets. Up to 255



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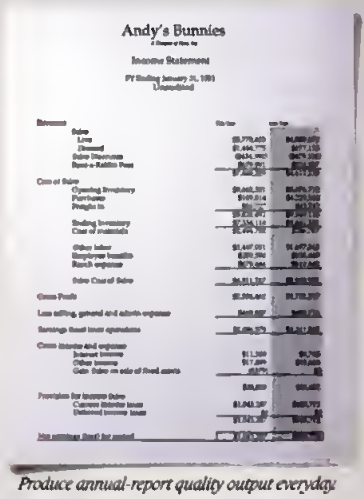
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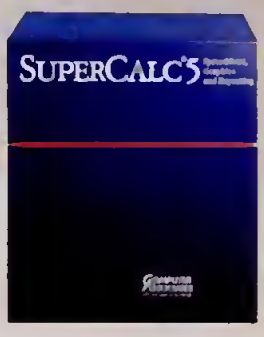
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Which finally brings us to our admittedly biased outlook for the much touted spreadsheet war.

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* EDITOR'S CHOICE 9/15/86



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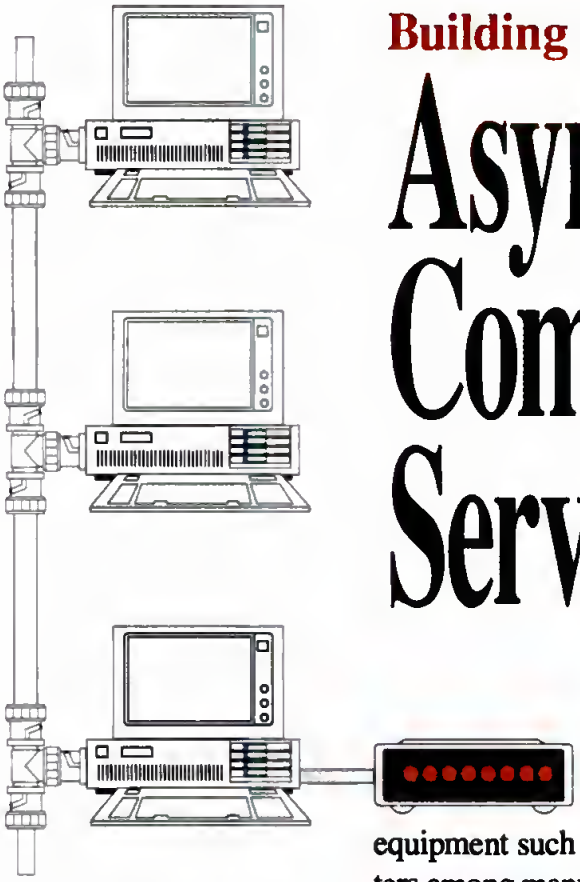
*These models provide interface for use with optional interface kits.

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CIRCLE 281 ON READER SERVICE CARD



Building Workgroup Solutions

Asynchronous Communications Servers

Modem sharing can be yet another benefit of LAN ownership if you invest in an asynchronous communications server.

One of the main reasons for installing a LAN is to spread the cost of expensive equipment such as large hard disks, laser printers, and plotters among many users. At first glance, it may not seem that you can use this kind of logic to justify purchasing a LAN to share a modem. After all, you can buy a 2,400-bit-per-second external modem for between $150 and $500, well under the cost of a network card.

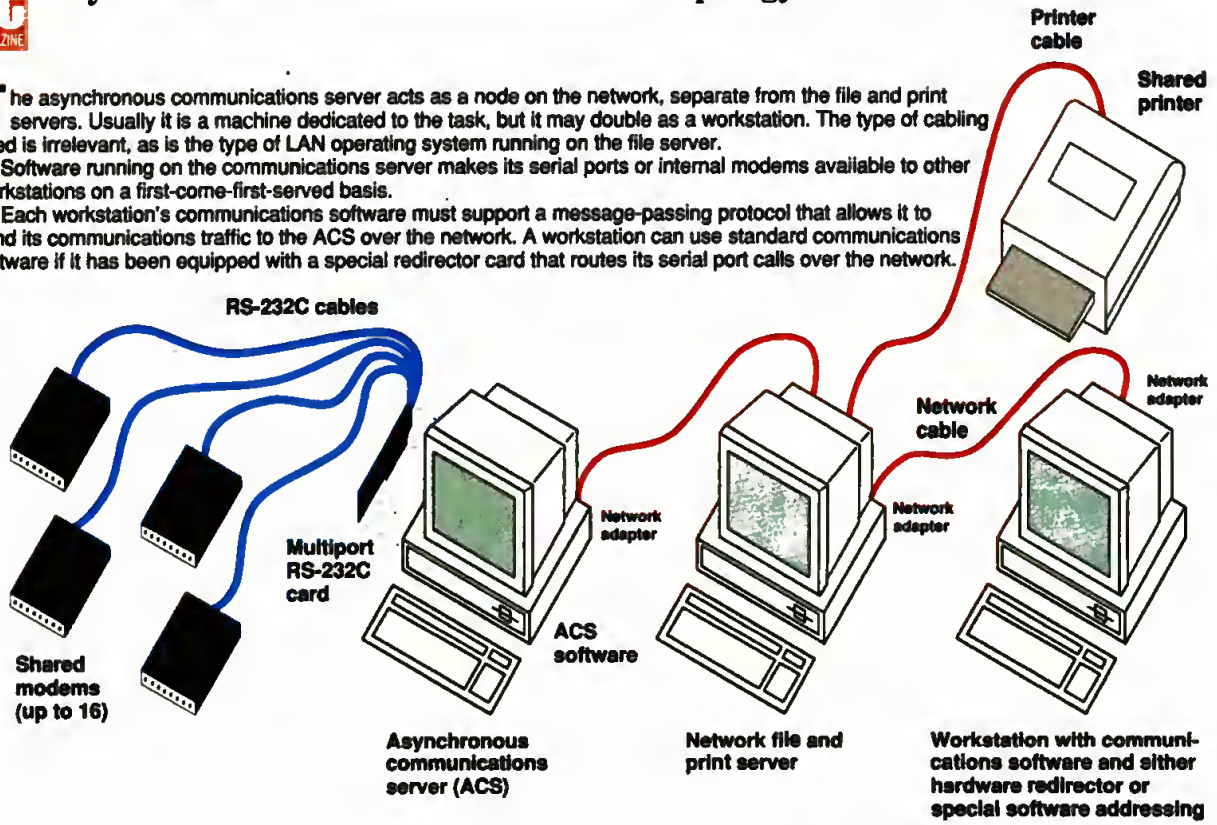
But it can be expensive to put a modem on every desk. For one thing, while the modems may be relatively cheap, extra business telephone lines for connecting them are not. Many office telephone systems use proprietary connection architectures and cannot accept modems without expensive add-in cards. Running additional phone wires to connect to modems can be a difficult and expensive chore, especially in older buildings. Finally, if you need the fastest connection permit-

Asynchronous Communications Server Topology

The asynchronous communications server acts as a node on the network, separate from the file and print servers. Usually it is a machine dedicated to the task, but it may double as a workstation. The type of cabling used is irrelevant, as is the type of LAN operating system running on the file server.

Software running on the communications server makes its serial ports or internal modems available to other workstations on a first-come-first-served basis.

Each workstation's communications software must support a message-passing protocol that allows it to send its communications traffic to the ACS over the network. A workstation can use standard communications software if it has been equipped with a special redirector card that routes its serial port calls over the network.



ted by today's technology, you'll have to pay a steep price for it: 9,600-bps modems still command $1,000 or more apiece.

These are all scenarios where an asynchronous communication server, or ACS for short, can make sense. Running on a workstation attached to the network, an ACS contains a number of serial ports (as many as 16) that are available to all users on the LAN on a first-come, first-served basis. If you already have a network installed, you can add an ACS to it for between $600 and $3,600, depending on the number of lines and the performance you need. Of course, you'll still need to install one or more phone lines for the modem, but only a fraction of the number you'd have to run to install modems at each workstation. Though the number required varies greatly depending upon need, four modems for 25 users should be adequate in most circumstances. And while costs vary considerably, it would certainly be less expensive to purchase one ACS, four modems, and four lines than to buy 25 modems and 25 lines.

■ It can be expensive to put a modem on every desk; additional phone lines are not cheap.

Since an ACS can handle many simultaneous 9,600-bps communications sessions, it allows you to share across the network those expensive new V.32 standard modems that are now coming into the market. An ACS can also help you to link your network to a mainframe or a minicomputer. By connecting a communications server port to a port on the big machine, you can give all network users the opportunity to log on without going to the expense of reserving a mainframe port for each user and running a separate RS-232 line to each of their desks.

SOFTWARE IS THE KEY Physically installing an ACS on your network is relatively straightforward. Since the ACS is an independent device that uses NetBIOS or a similar protocol to communicate with the workstations, you can install it on any type of network, regardless of the kind of cabling you use or the type of networking software you run in the file server. (The exception is Gateway Communications' G/Async II, which works only with Novell's *NetWare*.)

Getting it to work with your communications software can be a little trickier. For the network workstations to use the shared communications ports, each one must be

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equipped with some means of rerouting communications input and output to the ACS (see the sidebar "Many Ways to Send Messages to the Modem"). The ACS products reviewed here use different methods of doing this, each with its advantages and disadvantages; keep your software investment in mind as you read the reviews.

IBM and Novell both offer support for redirection to an ACS in their communications standards, and these standards are used by IBM's *Local Area Network Asynchronous Connection Server Program* and the Gateway Communications G/Async II products, respectively. J&L Products, Omnitel, and Crystal Point's *LineLock* all provide redirector software that runs on network workstations as an extension of DOS, communicating through the interrupt originally designed into the PC's ROM BIOS. These all-software approaches give every workstation access to the ACS without requiring that there be special hardware in each one. A number of major commercial software packages, such as *Crosstalk* and *Relay Gold*, support one or more of these standards.

■ J & L Products, Omnitel, and Crystal Point's *LineLock* provide redirector software that runs on network workstations as an extension of DOS.

If you want to use an off-the-shelf PC communications package, you'll have to install an add-in board in each workstation to do the rerouting in hardware, an option offered by Omnitel and J&L. The catch, of course, is that only workstations equipped with the redirector cards can access the ACS—no board, no communications. Moreover, you use up one of your workstation's expansion slots. But you might consider this restriction a security feature, as it physically prevents unauthorized workstations from using the ACS. Both the J&L and Omnitel products allow you to mix hardware- and software-redirector-equipped workstations on the same communications server, so you may be able to limit your hardware expense by equipping only those workstations that must use off-the-shelf software.

APPLES AND ORANGES The products we tested fell into two categories, dedicated and nondedicated. Dedicated units, represented by offerings from IBM, J&L, Crystal Point (*LineLock*), and Gateway/Network Products, require that the PC in which they are installed be used for nothing else. They are relatively expensive, especially when you add in the cost of an extra PC and a network connection. But in return, you get a heavy-duty server that can handle many simultaneous high-speed communications sessions with relatively little effect on performance and that is as expandable as your needs.

By contrast, the nondedicated systems (the Omnitel ACS System, Concept Development Systems' *Sparkle*, and Crystal Point's *PC-Term*) allow you to use the host computer as a network workstation at the same time it is handling communications. This is cheaper than dedicating a unit, making it a good option for small networks without extensive communications needs. But all of the nondedicated systems are significantly slower than the dedicated ones, and their performance falls off steeply as you add more than a few simultaneous sessions, enough to hamper foreground performance noticeably. The server software also takes a big bite out of your RAM supply, leaving less for your application programs. Essentially, you pay for flexibility with performance.

Ultimately, whether an ACS is for you depends largely on how many modems or serial lines you want to share and how heavily you plan to communicate. If you need to share a few modems occasionally, a nondedicated system may be a good bet. But first check the cost of installing a few extra modems for the people who need to use them most—it may be cheaper and more convenient.

If you have sophisticated communications needs—with many simultaneous sessions, high-speed modems, or serial connections to a minicomputer or a mainframe—one of the dedicated units is worth the cost. Especially on a large network, a dedicated system can significantly cut your investment in modems, ports, and phone lines. And the network can be expanded simply by adding more ports.

We've looked at six different ways to add an ACS to a network. The products come from eight different vendors: Concept Development Systems, Crystal Point, Gateway Communications, Network Products, Novell, IBM, J&L, and Omnitel. Ranging widely in price and capabilities, they collectively offer modem-sharing capabilities for all manner of users.
—Les Freed

CONCEPT DEVELOPMENT SYSTEMS INC.

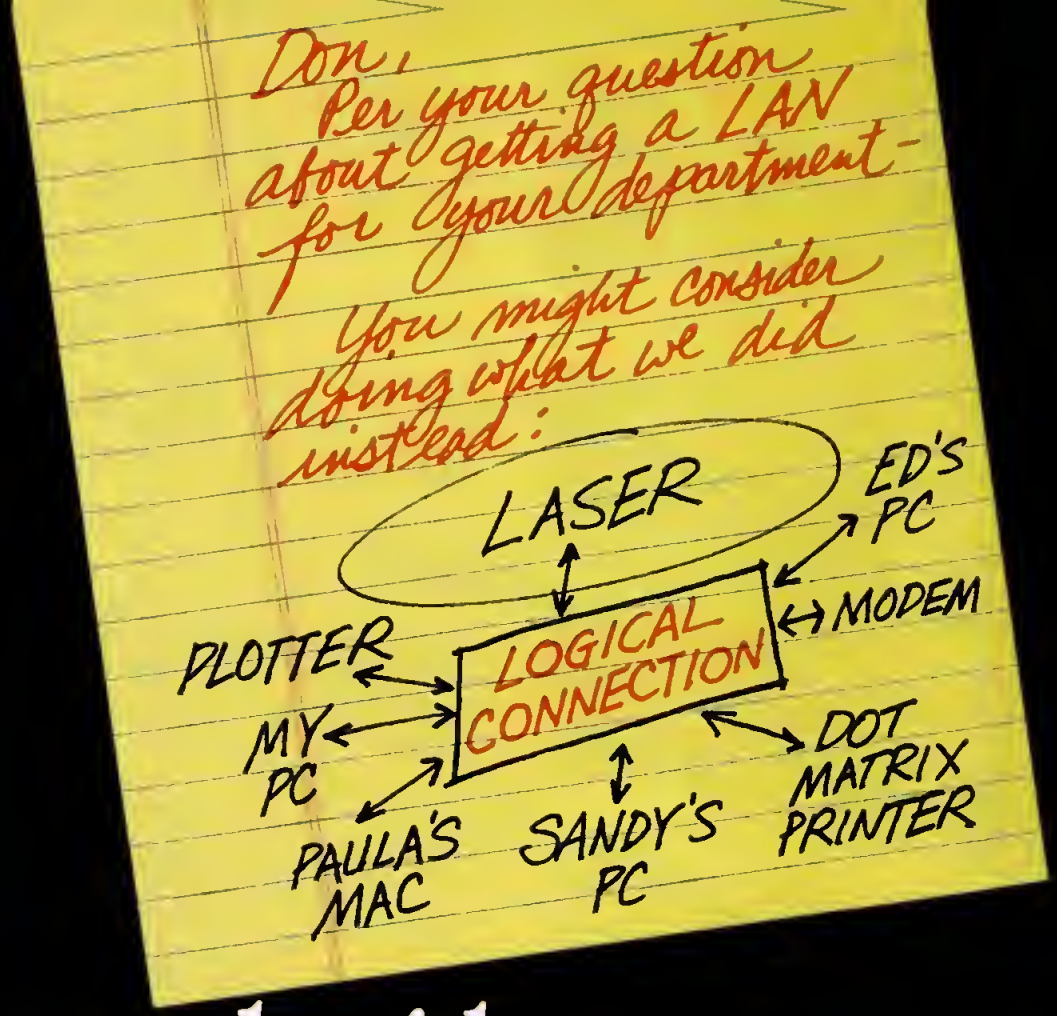
Sparkle

All that glitters is not gold, but *Sparkle* from Concept Development Systems (CDS) may save some of yours. At a bargain-rate price of $599, even infrequent communications users can recapture the software's cost quickly, and because it is an integrated software system with no hardware or communications program op-

PC MAGAZINE FACT FILE

***Sparkle*, Version 1.07**
Concept Development Systems Inc.
2775 Main St., Suite E
Kennesaw, GA 30144
(404) 424-6240
List Price: $599
Requires: Novell's *NetWare* or 100 percent NetBIOS-compatible network. Server: 39K RAM for share program; workstation: 300K RAM for Star program and 24K RAM on any one workstation in the network for the control program.
In Short: *Sparkle*'s low price and a decent assortment of features, such as its unique expert diagnostic system, makes this nondedicated software package acceptable for small networks with a few low-speed modems. But proprietary communications software and limited performance put a ceiling on growth possibilities.

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CIRCLE 320 ON READER SERVICE CARD



Sparkle *includes server software and its own communications package, Star. Included in the $599 package is an expert system for diagnosing problems.*

tions to cause confusion, *Sparkle* is fairly simple to use. But you pay with restrictions on software and with limitations on future growth.

Sparkle allows you to share the existing serial ports of any PC on a network with other network stations. Since it uses the 5C hex call of NetBIOS to communicate with the network, *Sparkle* should work with almost any of the modern LAN operating systems, most of which support the NetBIOS services. It also supports Novell's IPX interface when running on *NetWare* systems. A *Sparkle* server is nondedicated, so you can still use it to run other DOS programs at the same time.

■ *Sparkle* installs easily. The system software comes on four disks, whose files you copy into a shared subdirectory found on the file server.

Sparkle installs easily. The system software comes on four disks, and to install it you simply copy the files into a shared subdirectory on the file server. Two programs, which together take up about 63K of RAM in the machine acting as a communications server, make the machine's serial ports available to the rest of the network and give them network names so that they can be accessed by remote workstations running *Sparkle*'s Star communications software.

PROPRIETARY SOFTWARE *Sparkle* works only with its own proprietary communications software, which may sour its appeal if you're already wedded to another standard. But if you aren't, Star is adequate. Based on pull-down menus, it supports the usual array of basic communications functions, including dial-up directories, file transfers, and communications scripts. A simple audit feature, which lists each call with a description of the called party, the date, and the call's starting and ending times, is a nice touch that will be appreciated by your accounting department. Star does have a host mode, so that you can dial in to a workstation from another computer. But the remote computer must be equipped with CDS's *Line Plus Host* or *Sparkle Host* software.

The *Sparkle* software also includes Expert, a unique diagnostic program that uses expert system technology to help you tap the knowledge of communications specialists without calling them on the phone. Expert can furnish assistance in troubleshooting, setting up modems, and configuring serial cables, problems that plague even experienced communicators.

As a nondedicated system that runs in the background on an ordinary workstation, *Sparkle* has only a fraction of the throughput of the dedicated ACS packages that use processor-controlled serial ports. If two serial ports are busy with asynchronous traffic, performance slows considerably. Not surprisingly, the product's 9,600-bits-per-second transfer rate was poor, but the difference between it and the other nondedicated systems may have as much to do with the efficiency of its proprietary communications software as with the speed of the server itself.

Because of its simplicity and low cost, *Sparkle* may be an acceptable choice if your communications needs are simple and occasional. But *Sparkle*'s reliance on proprietary software is a hindrance if you need more flexibility or features than Star can deliver (although Version 2.0, released in February at the higher price of $895, should allow you to use more communications packages). If you ever expect to share more than a few 2,400-bps modems, you would do better to look at *PC-Term* or one of the dedicated systems.—**Randol Tigrett**

CRYSTAL POINT INC.

LineLock PC-Term

PC-Term, a menu-driven communications package from Crystal Point, is best known for its ability to emulate up to 23 different terminals, including those from Data General, Digital Equipment, Honeywell, Hewlett-Packard, and Zenith. But almost hidden away in Crystal Point's marketing is the fact that the network version of *PC-Term* can act as a nondedicated communications server. And if you want to move up to a dedicated system, Crystal Point offers *LineLock*, which works with *PC-Term* and adds unique monitoring and security features to your system.

PC-Term's network version addresses the NetBIOS communications services as well as the PC's standard serial ports. This allows you to use it with dedicated ACS systems that support NetBIOS calls, such as the G/Async II Gateway and Crystal Point's own *LineLock*. But *PC-Term* also comes with server software of its own that

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CIRCLE 171 ON READER SERVICE CARD



Crystal Point's PC-Term *shares a workstation's serial ports over NetBIOS networks.* LineLock, *a dedicated product that works with third-party serial boards, adds security features. The eight-node version of* PC-Term *is $649; the eight-port version of* LineLock *is $2,495.*

allows the workstation to share its local serial ports with other stations on the network. The license allows you to share the ports on all authorized workstations at once. *PC-Term*'s eight-workstation version costs $649.

Setting up *PC-Term* as a communications server is not too difficult if you follow the illustrations in the manual. You simply create an ASCII configuration file naming the type of serial resource (such as modems) that you want to make available and the memory address of the ports to which they are attached. The manual gives the most commonly used addresses for the standard DOS communications ports. The server module takes up about 16K of RAM, and if you're using a Novell network, you'll also have to load the NetBIOS emulator on top of your existing network shell, which takes up an additional 20K RAM.

Though you can use a *PC-Term* communications server as an ordinary workstation, you may not want to. Overall, *PC-Term*'s throughput in 9,600-bit-per-second file transfer tests was good for its class. But if the foreground program generates many interrupts, performance slows down enough to make Xmodem file transfers difficult.

ROOM TO GROW Fortunately, you can expand your *PC-Term* system to a dedicated system. *LineLock*, Crystal Point's dedicated ACS product, runs on a PC equipped with a multiport serial card or modem card, allowing its ports to be used by communications software running on network workstations. *LineLock* was designed for use with *PC-Term*, but the company also offers an INT 14 redirector driver for use with other packages that will support it.

At the time of our testing, Crystal Point offered the system with the Omnitel eight-port modem board, but the company says that it can work with any multiport board without an on-board processor, simply by setting it up with the proper memory address. Among intelligent multiport boards, the company currently supports the Star Gate ACL/8 and is working on drivers for other boards.

Not surprisingly, *LineLock* performs much better than *PC-Term* alone, working on a par with the other dedicated systems. For a software-only product, it carries a stiff price tag: the eight-port version sells for $2,495, in addition to the cost of the serial board and a PC to put it in. But in return, *LineLock* offers unique port management and security features that you may find indispensable if there is a risk of telephone abuse or intrusion on your network.

ACCOUNT CONTROL *LineLock*'s host mode, for example, supports automatic dialback to prevent hackers from breaking into the system from outside telephones. After a remote user dials in and logs on with a valid password, *LineLock* disconnects and then dials back to a prearranged telephone number. Since *LineLock* implements this feature in software, it works even with modems that don't have this feature designed into their hardware.

You can also use *LineLock* to control outgoing calls, restricting the use of a port to particular individuals or groups at different times. It monitors all the ports continuously and disconnects those that show no activity over a given period of time, preventing you from running up unnecessary charges.

If you bill for your services, you will appreciate *LineLock*'s activity reports. When you dial out through the *LineLock* system, you can assign a job number to the call. *LineLock*'s reporting module then lets you list your calls by user, department, job number, and/or telephone line. With this information, you'll quickly be able to spot malfunctioning or unused modems or telephone lines that might cost you money. *LineLock* also lets you set "budgets" in advance for each job so that you can limit the amount of time allowed on the line.

Since *LineLock*'s accounting feature is written in compiled *dBASE III* code, you can create your own reports by purchasing the source code from Crystal Point and modifying it to suit your needs.

MODEMS ONLY As with *PC-Term*, installing *LineLock* requires careful attention to the manual. Before you can run the program, you must insert a Set command

PC MAGAZINE FACT FILE

Crystal Point Inc.
12707 120th Ave. NE, #202
Kirkland, WA 98034
(206) 821-1909

PC-Term
List price: 8-workstation version, $649; 32-workstation version, $1,600.
Requires: server: 16K RAM for first modem, 4K for each additional modem; workstation: 135K RAM.

CIRCLE 429 ON READER SERVICE CARD

LineLock
List price: 8-port version, $2,495; 16-port version, $3,995; optional *dBASE* source code, $995.
Requires: server: a dedicated AT-compatible with 640K RAM.
In Short: The network version of Crystal Point's *PC-Term* communications software offers basic ACS services at a reasonable price. *LineLock*, a dedicated product, is very expensive and has its quirks, but it offers integrated security capabilities that are not to be found elsewhere.

CIRCLE 429 ON READER SERVICE CARD



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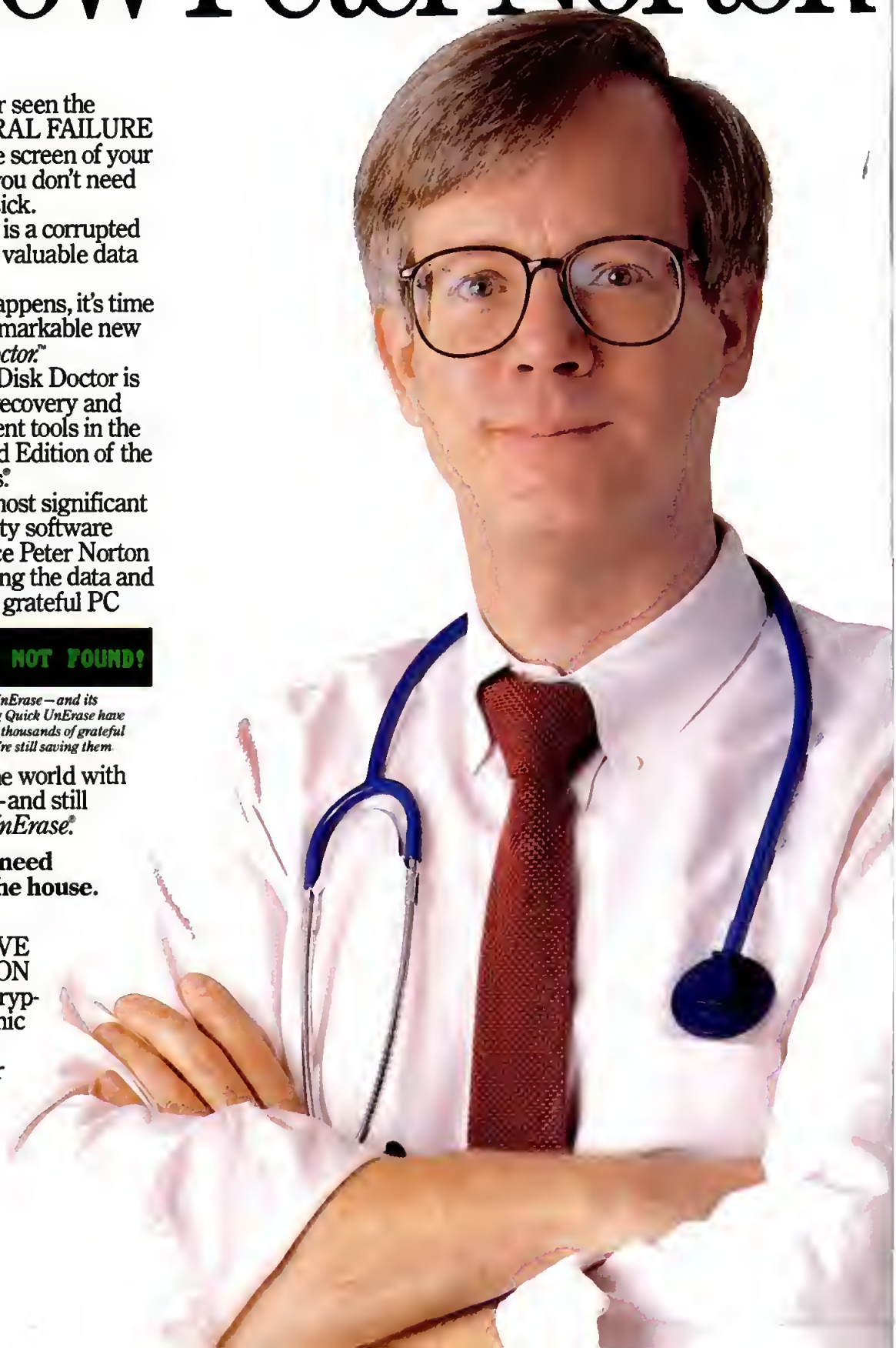
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COMPUTING

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CIRCLE 302 ON READER SERVICE CARD

into your AUTOEXEC.BAT to set an environment variable. You must then work your way carefully through the security menus. With a little care, the entire installation and setup procedure takes about an hour.

In fact, *LineLock* would be a clear candidate for Editor's Choice if its software were a little more robust. But the program needs more error trapping, particularly in the NetBIOS interface. For example, if you change a configuration or take certain actions on workstations, *LineLock* puts a NetBIOS ABEND error message on the top of the screen and then freezes, requiring you to reboot the workstation.

Another fault is its lack of support for direct serial connections. *LineLock* seems to be designed for modems alone; you can't tell it to ignore the carrier-detect signal, for example, which makes it very difficult to configure the system's serial ports for a direct serial line. So it is not the best choice if you want to use your ACS as a gateway to a minicomputer or mainframe.

TAKE YOUR PICK The Crystal Point products offer a good blend of flexibility, price, and performance. You can start out sharing a few modems with *PC-Term*, which is solid, easy to use, and inexpensive, and then expand to a more powerful dedicated system as your communications needs grow. *LineLock*'s integrated security features give you some real value for its high price. But you may be put off by its lack of support for direct connections and third-party communications software, as well as its imperfect error trapping.—**Frank J. Derfler, Jr.**

GATEWAY
COMMUNICATIONS INC.
G/Async II Gateway
NETWORK PRODUCTS INC.
Network Products ASC^2
NOVELL INC.
NACS

These three products are really the same item under different names. The software, called *ACS*^{2}, was written by Network Products to work on Novell networks with the intelligent four-port serial interface board made by Gateway Communications. Both Gateway and Network Products offer the full package for $1,595. Not to be outdone, Novell resells the package through its own distribution channel under the name NACS (for Netware Asynchronous Communications Server), but for a much higher price: $1,495 for the software, plus an additional $895 for the four-port serial board.



The G/Async II Gateway consists of a processor-controlled multiport serial port from Gateway Communications and server software from Network Products. The $1,595 package works with Novell's NetWare *networks.*

We examined both the Gateway and Network Products versions and determined that they were indeed identical, except that the cable supplied by Network Products was much longer than the one from Gateway. The manuals are different, since each company writes its own documentation; both are informative and easy to follow. The Network Products manual is slightly longer than Gateway Communication's and contains better illustrations and screen pictures.

NOVELL IPX SUPPORT The *ACS*^{2} server software requires a dedicated PC on the network. It conforms to Novell's NCSI communications standard, which uses Novell's IPX peer-to-peer communications protocol. Consequently, it runs only on Novell's *NetWare* networks, and you must use a communications program that supports IPX or one that has an IPX driver available as an option.

The software supports up to four Gateway G/Async II serial boards, each one with four serial ports, for a maximum of 16 ports per server. You can attach multiple communications servers to the network to expand capacity beyond this.

Like the DigiBoard serial board sold by J&L, each Gateway board has its own processor chip (in this case, a Zilog Z80) to do the heavy work of handling interrupts and buffering incoming characters. An octopus cable comes with the board and at-



A near-identical twin to the G/Async II Gateway, Network Products offers the same serial port and software, also for $1,595. The only difference is that Network provides a longer cable. Novell also sells the package under the NACS name at a much higher price.

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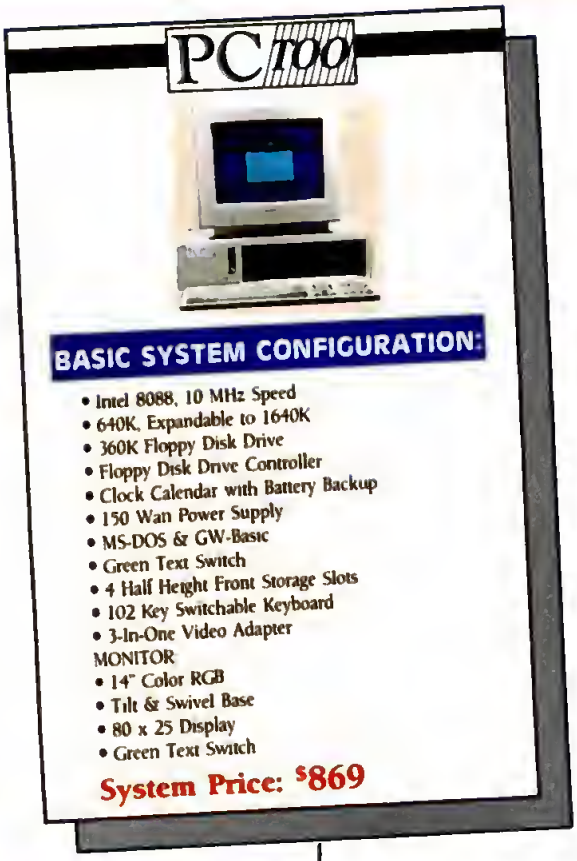
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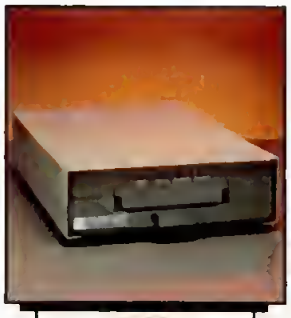
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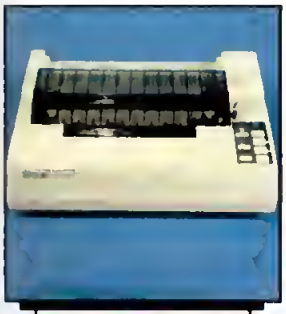


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■ COMMUNICATIONS

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G/ASYNC II Gateway — EDITOR'S CHOICE
Gateway Communications Inc.
2941 Alton Ave.
Irvine, CA 92714
(714) 553-1555
(800) 367-6555 outside Calif.
List Price: $1,595, including four-port serial card, modem cable, and *ACS*^{2} software.
CIRCLE 642 ON READER SERVICE CARD

Network Products ACS^2
Network Products Inc.
1111 South Arroyo Pkwy., #450
Pasadena, CA 91105
(818) 441-6504
List Price: *ACS*^{2} software and four-port RS-232 hardware kit, $1,595
CIRCLE 643 ON READER SERVICE CARD

NACS
Novell Inc.
122 E. 1700 South
Provo, UT 84601
(801) 379-5900
List Price: $1,495; WNIM+ four-port RS-232C adapter, $895.
Requires: Dedicated PC or compatible with 256K memory, Novell network with IPX interface; workstation: 26K RAM for TSR module.
CIRCLE 644 ON READER SERVICE CARD

In Short: Solid, reliable, and easy to install, the G/Async II Gateway is an excellent choice for Novell networks. Its support for Novell's IPX protocol means that no extra drivers are required in the workstations—a big plus in memory-squeezed installations.

taches at one end to a large connector on the rear of the board; the other end splits into four male DB-25 plugs. This is a convenient arrangement, especially if you are connecting modems to the board—you just plug in the modem cables and you're all set.

EASY TO INSTALL AND USE Of all the products we tested, the G/Async II Gateway was the easiest to set up and operate. Since there is no special driver software or hardware required at the workstation, there is no possibility of anything going wrong at the workstation end.

The software installs easily, using a program that guides you through the steps of adding serial boards to the server unit and configuring each port. Once the server

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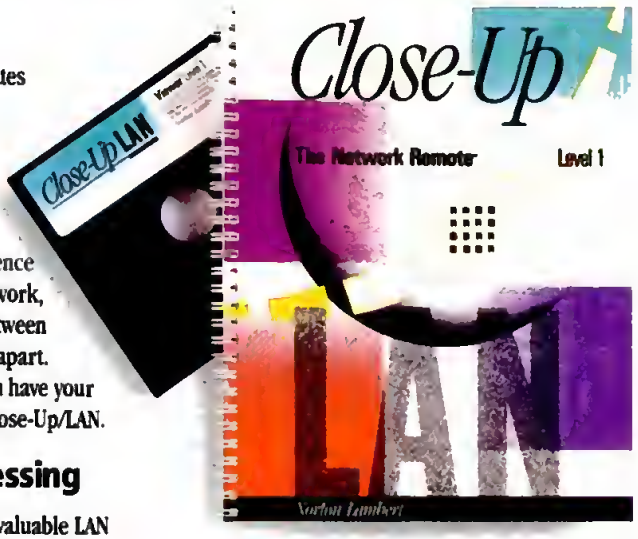
Hot key again and off you go on your rounds of the company. Viewing one screen after another, helping some, watching others. All from the comfort of your chair. Finished, you hot key back to your spreadsheet and carry on with your budget. Amazed, you think that support has never been this easy before.

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is up and running, you load your communications software on the workstation, and you're ready to go.

A status display on the server's screen helps you to monitor the ports and to clear stuck ports. It should be familiar to *NetWare* users because it is very similar to the *NetWare* file-server monitor display.

The product performed well. Its throughput was very high, and we noticed very little echo delay. Since this system uses IPX, which is loaded on each workstation at boot time, no additional memory-resident drivers or programs are required. This saves memory space on the workstation and should also cut down on compatibility problems.

For most Novell *NetWare* users with average communications needs, the G/Async II Gateway will be the ACS of choice. Based on Novell's own communications standard, it requires no troublesome drivers or redirector cards; hence it is easy to install and reliable. Its utilities are well integrated into the *NetWare* operating system, it comes at a good price, and it is well supported by its three parents.

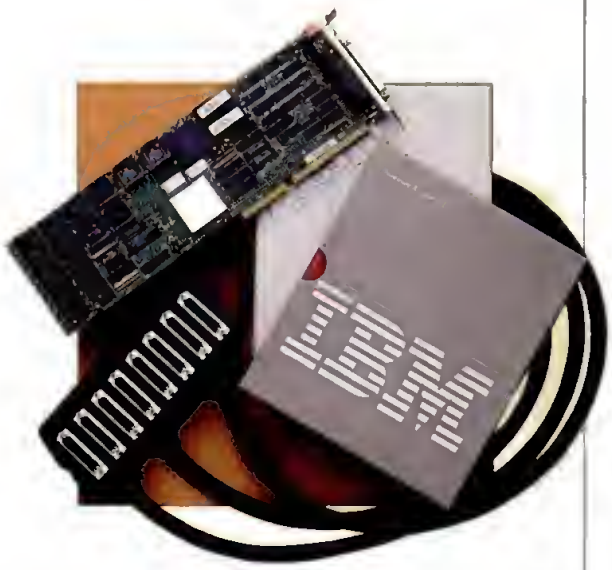
—Les Freed

IBM CORP.

IBM LAN ACS Program

IBM Local Area Network Asynchronous Connection Server Program (*IBM LAN ACS Program*) has the look and feel of IBM's mainframe software: competent but arcane. The software does very little for you in the way of prompting or guiding you through its tasks, and it requires someone of the caliber of a systems programmer to set it up. Once you get it running, however, it is fast and highly reliable.

The *IBM LAN ACS* is a powerful, $1,260 software package that controls up to 32 serial ports on IBM's Asynchronous Realtime Interface Co-Processor (ARTIC) multiport serial adapter, and makes them available across an IBM Token-Ring Network or PC Lan II Network. As the impressive name indicates, this series of boards comes with its own processors, which contribute significantly to *LAN ACS*'s excellent performance when running with this hardware configuration.



IBM's $1,260 LAN ACS server software can share up to 32 serial ports on IBM's ARTIC cards. You add serial ports to the base card in four- or eight-port increments; both PC and Micro Channel buses are supported.

(The software can also share ordinary serial ports on a dedicated PC over the network, but its performance in this mode is so mediocre that you won't want to.)

The ARTIC boards are available in both PC-Bus and Micro Channel versions. In the PC-Bus version, you buy a basic communications board for $1,110, and then add either a four-port serial adapter (daughtercard) for $188 or an eight-port adapter (RS-232 card) for $310, as well as an octopus connecting cable for $220. The slightly different arrangements for the Micro Channel package come to about $1,600 when you add the prices of the separate packages.

LAN ACS can work with any file server software, but it requires IBM's *PC LAN Support Program* to supply the NetBIOS services it needs for communicating over the network. A number of communications programs, including *Crosstalk*, *PFS:Access*, *Reflection*, and others are available in ACSI versions.

IBM does not offer the option of using standard PC communications software, as J&L and Omnitel do. However, *LAN ACS* does support the newer "enhanced BIOS" interface based on INT 14 (see the sidebar "Many Ways to Send Messages to the Modem"). The INT 14 (interrupt 14) redirector is a device driver loaded into each workstation at boot time with CONFIG.SYS, so it uses up 20K of RAM whether you are using the asynchronous server or not.

The system can manage both interfaces simultaneously, so you can use workstations running ACSI and INT 14 communications software on the same network. IBM says that there is no noticeable difference in performance between the two protocols, and this finding was confirmed in our benchmark tests.

COMPLEX INSTALLATION Though *LAN ACS* has impressive specifications, it falls down in the area of installation.

PC MAGAZINE FACT FILE

IBM LAN ACS Program
IBM Corp.
Address: See your local IBM dealer.
List Price: Software, $1,260; ARTIC M adapter with 128K for PC bus, $1,110; four-port daughtercard, $188; cable, $220. ARTIC M/2 for Micro Channel with 512K RAM, $1,025; eight-port RS-232 card, $310; cable, $220. Each ARTIC card also needs a DOS support package ($80).
Requires: IBM PC-DOS, Version 3.3; *IBM PC LAN Support Program;* IBM Token-Ring Network or PC LAN II Network Interface Card; server: 256K RAM; workstation: 20K RAM for TSR module.
In Short: As befits a product influenced by the mainframe world, IBM's Connection Server is powerful, complex, expensive, and difficult to understand. Installation should not be attempted without thorough preparation, but once the system is operational, it gives reliable and speedy performance for heavy-duty communications.
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Performance Tests: Asynchronous Communications Servers

The performance test results are sharply divided between those systems using a dedicated server and those using a non-dedicated server that also acts as an ordinary workstation. Multiple serial ports generate a lot of work for the processor, and dedicated systems can handle it better.

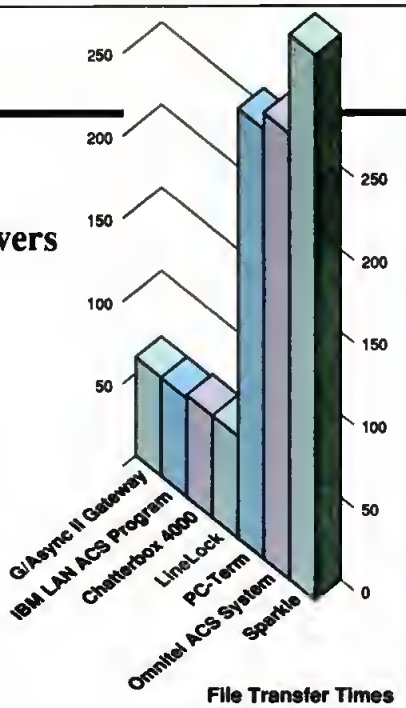
The dedicated systems make use of independent processors on their serial cards to take the load of servicing interrupts and buffering the communications flow off the main processor. All four dedicated systems delivered comparable performance, finishing the 50K File Transfer Times test in about a minute.

By contrast, the nondedicated systems share the CPU in the host system, which must work heavily to service the interrupts generated by even a few busy serial ports, and which may also be busy running a foreground application. Not surprisingly, all of these products were significantly slower than the dedicated systems, with file transfer times ranging from 260 to 330 seconds. At least some of the variation among them can be ascribed to differences in communications software. *PC-Term* and *Sparkle* work only with the communications software provided by the manufacturer, while the Omnitel ACS System was tested using *Crosstalk* like the dedicated units.

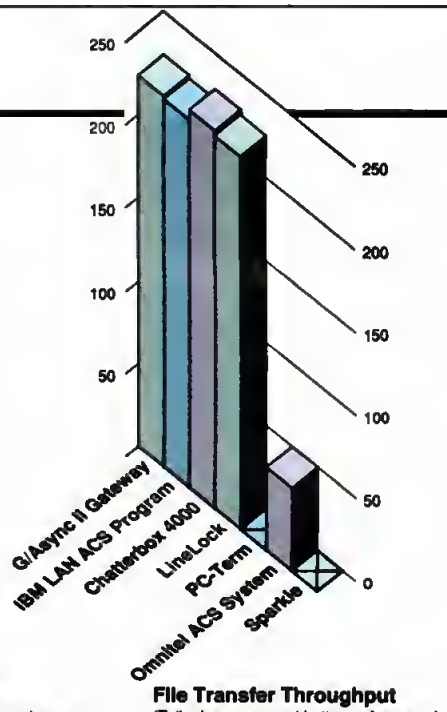
Another drag on the nondedicated systems' performance is the echo delay that is characteristic of all communications servers. Echo delay is the mortal enemy of file transfer protocols such as CompuServe B or Xmodem, in which the sending station sends a block (or packet) of characters and then pauses to wait for an acknowledgement or a retry request from the other end. While the sender is waiting for the response, the station cannot send any more characters, so any delay in the connection between the two systems reduces the throughput significantly.

The severity of echo delay is affected by many factors, among them the ability of the serial ports in the ACS to operate without heavily loading the communication server's processor, and the amount of processor time dedicated to the ACS tasks. The effects of this delay can be seen all too clearly in the File Transfer Throughput test results for the Omnitel—the only nondedicated system that could run the test. Its throughput score was less than 25 percent of what the dedicated systems achieved.

The message of the tests is clear. If your communications needs are minimal, sharing only a few low-speed modems among several workstations, one of the low-cost nondedicated systems may be adequate. But if your network users plan to communicate frequently over many ports at once, and especially if you use high-speed 9,600-bps modems, only a dedicated system will give you acceptable performance.



File Transfer Times
(Shorter bars represent better performance)



File Transfer Throughput
(Taller bars represent better performance)

	File Transfer Times (seconds)	File Transfer Throughput (cps)
G/Async II Geteway*	60	224
IBM LAN ACS Program	60	222
Chetterbox 4000	62	228
LineLock	62	225
PC-Term	260	N/A
Omnitel ACS System	270	50
Sparkle	330	N/A

* The same product is also marketed as the Network Products ACS² and as Novell's NACS.
N/A—Not applicable: these software products could not perform the test.

Whenever possible, we try to compare products under exactly the same circumstances. But since J&L provided us with a complete system, including a 286-based processor unit, we decided to test it using the Chatterbox as a communications server. The other ACS products were tested on Dell System 200 workstations, which are comparable 10-MHz 80286 systems.

All of the servers were tested with at least four serial ports installed (the G/Async II Gateway, Chatterbox 4000, and Omnitel ACS System were tested with eight ports). In the Omnitel unit, four of the serial ports were dedicated to 2,400-bps internal modems, with the other four dedicated to direct connections. *LineLock*, an all-software product, was tested with Omnitel's four-port serial board, while *PC-Term* and *Sparkle* were tested with standard PC serial cards.

IBM LAN ACS Program was tested using IBM Token-Ring adapters and IBM's Local Area Network Support Program. All of the other products were tested on a 10-node Ethernet network running Novell's *NetWare* 2.12 and using 3Com's 3C503 EtherLink II network adapters. For consistency, the tests were conducted when there was no other traffic on the network. Since both types of networks have significantly greater throughput than a serial link does, the different network configurations should have had no effect on the results.

The products have different requirements in terms of communications software. For our tests we used *Crosstalk Mk 4*, Version 1.1, since it comes with drivers for INT 14, IBM's NetBIOS ACS protocol, and Novell's NASI standard, as well as for standard serial ports. The exceptions were *PC-Term* and *Sparkle*, where we had to use the proprietary communications programs that came with them.

To confirm the compatibility of these products with an industry-standard 9,600-bps modem, we used modems from Universal Data Systems, a brand that adheres closely to the V.32 standard and is often found in commercial modem-pool installations. In our test, we dialed out on one phone line and came back in on another through the local telephone switching network.

We performed two series of file transfer tests. For the first, **File Transfer Times**, we connected two ports on the server together through a null-modem cable and transferred a 50K random binary file from one port to the other, timing the test with a stopwatch. The files were transferred between 110K RAM disks on the sending and receiving workstations, eliminating the effects of drive access delays and keeping network traffic to a minimum.

For the second test, **File Transfer Throughput**, we downloaded a 26K file from CompuServe using CompuServe's B protocol at 2,400 bps, and we recorded the throughput that *Crosstalk* reported at the end of the transfer. Naturally, this test could not be performed using *PC-Term* or *Sparkle* software, which do not report the throughput rate.

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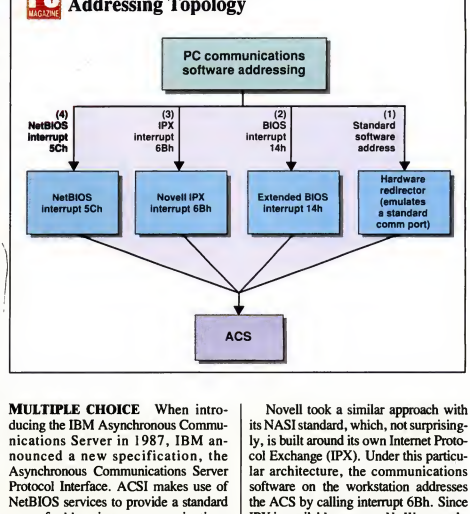
MANY WAYS TO SEND MESSAGES TO THE MODEM

There are many possible ways to access a serial port over a network. In the past few years, a number of different, incompatible methods for communications software to talk to a port on an asynchronous communications server have emerged, but so far none has become a standard.

When IBM first designed the PC, its engineers selected Western Digital's 8250 UART chip to control the serial ports. They also included a set of software routines in the PC's ROM BIOS so that programmers could communicate with the chip. Because these routines are addressed through software interrupt 14, they are known as INT 14 routines.

Unfortunately, the INT 14 routines built into the PC's BIOS aren't of much use to designers of communications software. They appear to have been designed with serial printers in mind; they fail to provide the fast interrupt-driven input and output needed to communicate with modems. Early on, programmers realized that the only way to get good performance out of the PC's serial ports was to address the 8250 chip directly. Nearly all communications packages on the market today do this.

This situation is analogous to the way that most application programs interact with the PC's screen display. Although IBM provides a BIOS video interface (INT 10) for programmers to use, most application developers have found that it just doesn't have the performance required to execute the fast screen updates PC users expect. Consequently, most programs write data directly to the video hardware, bypassing INT 10 entirely.



MULTIPLE CHOICE When introducing the IBM Asynchronous Communications Server in 1987, IBM announced a new specification, the Asynchronous Communications Server Protocol Interface. ACSI makes use of NetBIOS services to provide a standard way of addressing a communications server over a network. Though supported by a number of major packages, it never caught on among ACS products not made by IBM.

Novell took a similar approach with its NASI standard, which, not surprisingly, is built around its own Internet Protocol Exchange (IPX). Under this particular architecture, the communications software on the workstation addresses the ACS by calling interrupt 6Bh. Since IPX is available on every *NetWare* workstation that Novell markets, no special drivers are needed. But the Novell protocol is incompatible with standard PC communications software, so you must

IBM's documentation is uneven, in some areas covering the material comprehensively and in others treating important points in a single, terse sentence.

The manual includes several LAN session worksheets and a large poster describing, in exquisite detail, how to record which users use which services, the network names associated with the services, and so on. You need this information to build a detailed configuration file that includes commands to create organizational log-on greetings and instructions. The file is literally a script for the program, giving total control over who can use what kind of resource. Its security system is reasonably complete but doesn't include two important features, and automatic dialback or time-of-day restrictions.

Unfortunately, the documentation doesn't tell you clearly how to run the software once you've installed it. Various programs that are needed to run on the workstations also aren't described well. For this

use a package specifically written to support Novell's communications interface. Novell has published the NASI standard, and a number of software vendors have implemented it in their application programs.

For other types of networks, the most common method of communicating with the ACS is an extension of IBM's original INT 14 interface. In this scheme, the communications program continues to address INT 14, but special memory-resident redirection software routes the message away from the PC's internal ROM BIOS to NetBIOS or another network communications protocol, which in turn passes it along over the network to the communications server. Unfortunately, not all of the more popular communications software supports INT 14 calls, but extended INT 14 has the advantage of being a nonproprietary starting point that most programmers are familiar with, at least in passing.

Full compatibility with off-the-shelf communications software requires a hardware-based solution. The type of communications redirector board offered by Omnitel and J&L Products works by pretending to be an 8250-type serial port controller. The software treats it exactly like an ordinary PC serial port (COM1 through COM4), but the board routes the communications to the ACS via NetBIOS or other calls. This solution has a big advantage over the others in that it can use standard communications software that writes directly to the 8250 controller hardware. But it requires you to install a board in each workstation.
—Les Freed

reason, prior experience with a *LAN ACS* installation or a course at IBM's training school is a must for anyone installing this program.

PROFESSIONAL UTILITIES As *LAN ACS* runs, a monitor screen on the dedicated server unit reports on the status of the available ports and who is connected to them. You can also direct this information to a log file for future analysis if you like.

Another useful utility is Trace, which captures every bit transmitted through the server and can perform a complete dump of this activity for troubleshooting purposes. This capability is common in SNA servers but unique to PC asynchronous communications servers. Trace isn't something that you run all the time since it slows the server and you need an expert to interpret its results. But it can be a lifesaver in some situations.

IBM's entry in the ACS sweepstakes is an acceptable choice if you own an IBM shop and can depend on Big Blue to do your installation and maintenance. But unless you're skilled at installing this system, you should bypass it in favor of the J&L Chatterbox or one of the other dedicated ACS products, which offer comparable performance with fewer installation headaches.**—Frank J. Derfler, Jr.**

J&L PRODUCTS
Chatterbox 4000

The Chatterbox 4000 and *NCS* software from J&L Products is more than just an ACS. It's an assortment of products you can use to tailor a powerful communications server system to meet your needs.

The Chatterbox system requires a dedicated PC as the "guts" of the server. But unlike the other dedicated systems in this review, you don't have to put everything together yourself. J&L Products will sell you the case, processor, serial interface boards, and server software as a complete package. If you already have a spare machine to use as a server, you can purchase the serial boards and J&L's *NCS* software separately. But it is as a complete system that the J&L Chatterbox really shines.

MIX AND MATCH The model we tested was the Chatterbox 4000, an AT-compatible tower-style chassis containing a hefty power supply, a motherboard with 20 AT-style expansion slots, and a large drive bay that will hold up to four half-height units. At first glance, 20 slots may seem an enormous number for a single system, but closer inspection reveals that its slots are arranged in four groups of five



With J&L's Chatterbox 4000, you can purchase the processor cards and multiport serial cards separately or as part of a dedicated AT-compatible communications server. Prices vary depending upan configuration.

slots each. Thus, the Chatterbox is really several separate AT-class machines in a single cabinet. (J&L also offers the Model 6000, containing one group of five slots and five groups of three slots.)

You can custom configure these processors, combining asynchronous communications servers, file servers, workstations, 3270 gateways, or any combination of these into one chassis. All the machines operate independently, with independent status panels and reset buttons, although they share the same power supply.

Our test system, set up as a dedicated communications server, was built around J&L's CPU board set, which is a complete 80286 system on two cards with 512K of RAM, a keyboard interface, a monochrome video interface, a serial port, and the circuitry to drive the status lights on the front of the cabinet. To it we added an eight-port DigiBoard serial board that contains its own 10-MHz 80188 processor and shares data with the central processor through dual-ported RAM, freeing the

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Chatterbox 4000
J&L Products
9238 Deering Ave.
Chatsworth, CA 91311
(818) 709-1778
(404) 233-6969 (on the East Coast)
List Price: Chatterbox 4000 in configurations ranging from one to four 286 CPUs, $2,995–$7,195; J&L's *NCS* (network communication server) software (available in both Novell IPX and NetBIOS versions) plus four-port DigiBoard serial board, $1,645; with eight-port DigiBoard, $1,895; optional JL-NCA (network communications adapter) card (for most communications programs), $95.
Requires: server: Dedicated PC/XT/AT or PS/2-compatible computer with at least 256K RAM, including J&L's Chatterbox unit. *NCS* software: 50K RAM. Workstation: 15.5K RAM for each RRIM (RAM-resident interface module). Additional memory may be necessary depending upon card and/or communications software requirements.
In Short: Unmatched for its combination of flexibility and performance, the Chatterbox is the best of this lot for those with demanding communications requirements. The ability to combine several servers into one chassis, and J&L's one-stop approach to supplying network equipment, should be a big recommendation for systems integrators trying to put together large networks.

CIRCLE 546 ON READER SERVICE CARD

main processor from handling incoming interrupts. A disk controller board, a 5¼-inch floppy disk drive, and a 3Com Ethernet board completed the package.

FLEXIBLE POWER J&L's *NCS* software is easy to install and supports up to 16 serial ports per server. It is available in versions for either NetBIOS or Novell's IPX peer-to-peer communications protocol. If you are running Novell's *NetWare*, you should opt for the IPX version of the server software. Otherwise you'll use the NetBIOS version, which should run on any NetBIOS-compatible network, including IBM's *PC LAN Program* and the various networks that use Microsoft's *OS/2 LAN Manager*. The two versions of the server software are otherwise identical.

You have two choices for setting up the workstation end of the connection. If you want to run standard "off-the-shelf" communications software, you'll need J&L's JL-NCA (network communications adapter) card, a small board that installs in a free slot in each workstation that will access the server and emulates a standard serial port. A Micro Channel version of the NCA card is also available.

If you don't want to give up an expansion slot in each workstation, J&L also offers a software solution in the form of its INT 14 redirector software. The drivers each take up about 15K of RAM, but since you can unload them from the command line, you'll generally be able to recover this space at the end of your communications session. If you choose this option, your communications software must support INT 14. You can, however, use workstations equipped with either redirection solution on the same communications server simultaneously.

CLAIMING A PORT To establish a serial connection through the server, you must load the appropriate driver for your NCA board or INT 14 redirector and use the program NCSPORT to select a free port of the appropriate type on the server before starting your communications software. Once you have "claimed" a port, it belongs to you until you release it. This allows you to make several modem calls without exiting the communications program. When you're done with the port, use NCSPORT again to release the connection.

Both the driver software and NCSPORT can be run from the DOS command line, so you can automate this process in a batch file. Since the server's communications ports can be categorized by type, the workstation can distinguish between ports attached to low-speed modems, high-speed modems, and serial lines (to a minicomputer, for example). Rather than having to remember which port is connected to what, you simply select the group.

If you don't specify any command-line switches, NCSPORT displays a menu of options. We liked this feature, since it allows you to create batch files for commonly used setups but still lets you see all the available options when you need to.

The display attached to the communications server shows a status screen that allows you to monitor any group of eight ports. Detailed information on each port is available, and you can release "stuck" ports by issuing commands from the server keyboard.

A WINNER We found the J&L system to be a robust performer. File transfer throughput was excellent. The server software operated flawlessly, maintaining its performance even with two network workstations doing 9,600-bit-per-second file transfers simultaneously. Throughput was slightly higher with the NCA card than with the INT 14 redirector software. Echo delay in our CompuServe download test was minimal.

The Chatterbox doesn't come for nothing, but it is the choice you should make if you need the greatest possible flexibility and throughput for a large network. System integrators and value-added resellers will especially appreciate its comprehensive design, which allows you to get everything you need to build a full-featured server in a single cabinet from a single source.—**Les Freed**

OMNITEL INC.

Omnitel ACS System

Unlike the other nondedicated systems reviewed here, Omnitel's ACS System allows you to mix and match to suit your needs. On the server end, you can choose either serial ports or Hayes-compatible internal modems in groups of four, up to a maximum of 16 ports per server. And at the workstation end, Omnitel supports a wide range of software through both hardware- and software-based redirector options. But it still suffers from the relatively low performance of a nondedicated unit.

Omnitel's four-port serial board has no on-board processor. An octopus cable plugs into a large connector on the rear of the board and supplies four male DB-25 connectors at the other end. The modem board, which comes in 2,400-bit-per-second and 1,200-bps versions, contains four Hayes-compatible modems on a single full-length card. Due to the tight space on the card, no speakers are included.

The Omnitel server software runs in the background under DOS, so you can run other applications on the communications

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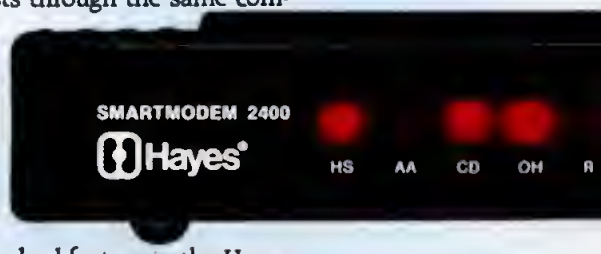
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CIRCLE 136 ON READER SERVICE CARD



Unlike the dedicated systems, Omnitel's multiport serial board does not have its own processor. The $999 server software runs in the background on a network workstation.

server. Configuring the server for eight ports, however, requires 128K of memory over and above that required to load DOS and NetBIOS. Even on a 640K machine, this doesn't really allow much RAM workspace for running local applications.

Moreover, since the server software eats up most of the available CPU time even on a 10-MHz 80286 system, you are probably better off running it as a dedicated communications server. Unfortunately, Omnitel has not found a way to make the server software a foreground task receiving 100 percent of the processor's attention. Omnitel, however, does include a monitor program that runs in the foreground and gives a nice display of the status of each of the eight ports.

FREEDOM OF CHOICE Installing the server software is straightforward. You copy the ACS files to the hard disk on the machine that will become the communications server and then use a setup program to tell the server software what type of multiport serial boards you have. You can designate each port on the server as either a modem or a direct connection. This kind of addressing makes it easy to mix different kinds of serial devices on the same communications server.

Like J&L Products, Omnitel gives you a choice of a software-based redirector that works with communications packages supporting INT 14 or a hardware redirector card (called the V-COM card) that works with standard PC communications software. The V-COM card is a half-size unit that you plug into an 8-bit expansion slot in the workstation, after setting DIP switches to select the DOS communication port (COM1 through COM4) to which the V-COM will correspond.

To use the server, you simply run a program (VCOM) to select a free port, then start your communications software. You can use the setup program to configure VCOM for any number of workstations, referring to individual configurations by number when starting the workstation. Thus on any one network, some users may use the V-COM card while others are using the INT 14 interface. The only inconvenience is that the VCOM settings can't be changed once the program is loaded. If you make a mistake and load the wrong configuration for your workstation, you must reboot it.

NEITHER FISH NOR FOWL Weighing against the Omnitel's flexibility and wealth of features is its weak performance.

The Omnitel board's lack of an independent processor to manage the communications traffic is immediately apparent. With this design, all the serial ports must share the same interrupt line, and the server's CPU has to check all eight ports each time a character comes in, which puts quite a burden on it. Performance was acceptable with the four-modem board installed, but deteriorated noticeably when the four-

PC MAGAZINE EDITOR'S CHOICE

- **Chatterbox 4000**
- **G/Async II Gateway**

Since network installations vary, we recommend two of the dedicated ACS products.

If you are installing an ACS on a Novell NetWare *system, you should look first at Gateway Communications' G/Async II Gateway. This is a high-quality dedicated system with good integration into the* NetWare *operating system and the right price. Although both Novell and Network Products sell the same product, Gateway offers the best value as a whole because of the company's superior support.*

For other networks—and especially large ones with heavy communications needs—J&L Products' Chatterbox 4000 is the outstanding choice. J&L's NCS *software is fast and reliable, and you don't have to be a systems programmer to install it. It is an especially good choice for system integrators who want to bring full communications capabilities to a LAN in a single package. With its clustered slots that give you the ability to integrate file servers and gateways into the same cabinet as your communications server, the Chatterbox offers you a way out of the rat's nest of interconnections and the selection difficulties that come with multivendor setups.*

Among the nondedicated systems, honorable mention is due to Crystal Point's PC-Term. *For the price of a communications software package, it gives you the basic ability to share the serial ports on your workstations over the network.* PC-Term*'s server software is solid, reasonably easy to install, and uses relatively little RAM. If your communications needs are modest, it can represent an excellent bargain.*

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■ COMMUNICATIONS

PC MAGAZINE FACT FILE

Omnitel ACS System
Omnitel Inc.
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(415) 490-2202
List Price: ACS software, $999; NQ2400 four-port, 2,400-bps internal modem card, $1,799; NQ1200 four-port, 1,200-bps internal modem card, $899; NQSER four-port serial card, $399; V-COM hardware redirector, $99; V-COM, Micro Channel version, $149.
Requires: PC/XT/AT or compatible computer; server: 45K RAM plus memory for buffers determined by user; workstation: 48K RAM.
In Short: Omnitel's ACS offers exceptional flexibility in a nondedicated system, giving you a choice of serial ports and internal modems on the server and allowing you to use either INT 14 or standard communications software. But the Omnitel simply hasn't the horsepower to keep up with the dedicated systems, especially when loaded with more than four ports.

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port serial board was added.

Like the other nondedicated systems, we noticed a considerable amount of echo delay when typing to a host computer at 9,600 bps. Not surprisingly, the Omnitel performed relatively slowly on our CompuServe download benchmark test, clocking in at 50 characters per second (cps) compared with the 228 cps attained by the dedicated J&L system.

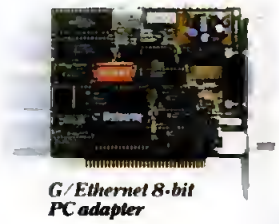
The Omnitel is much more flexible than the other nondedicated systems, but it is also more expensive. If your needs are fairly modest (no more than four ports) and you have to use standard communications software, the Omnitel may be for you. But it's no substitute for a dedicated unit, and if you just want to share a few modems occasionally, you may be able to get what you want for less.—**Les Freed**

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine. *Les Freed, formerly of DCA, is an expert in asynchronous communications and the author of the original* Crosstalk *communications program. Randol Tigrett is project leader at PC LAN Labs.*

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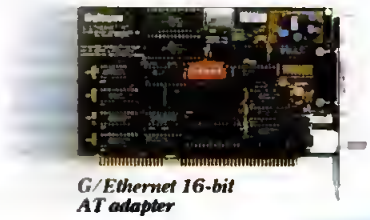
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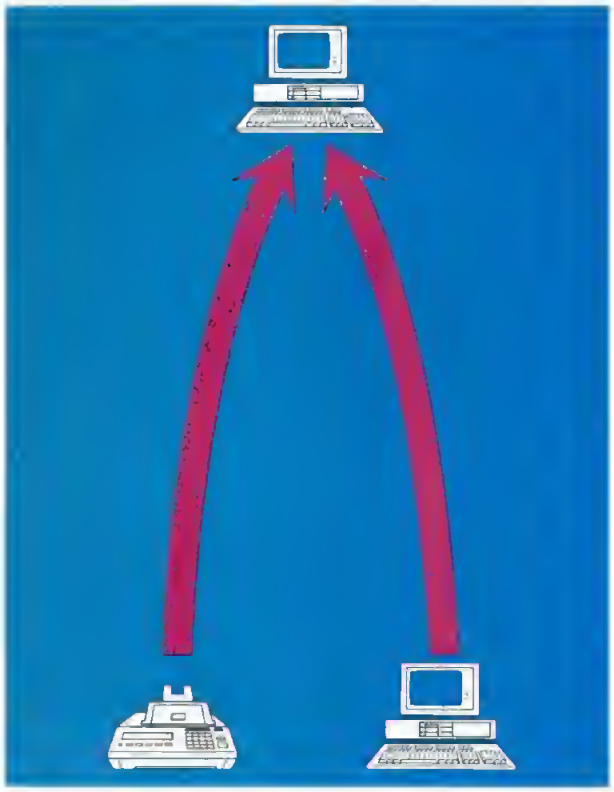
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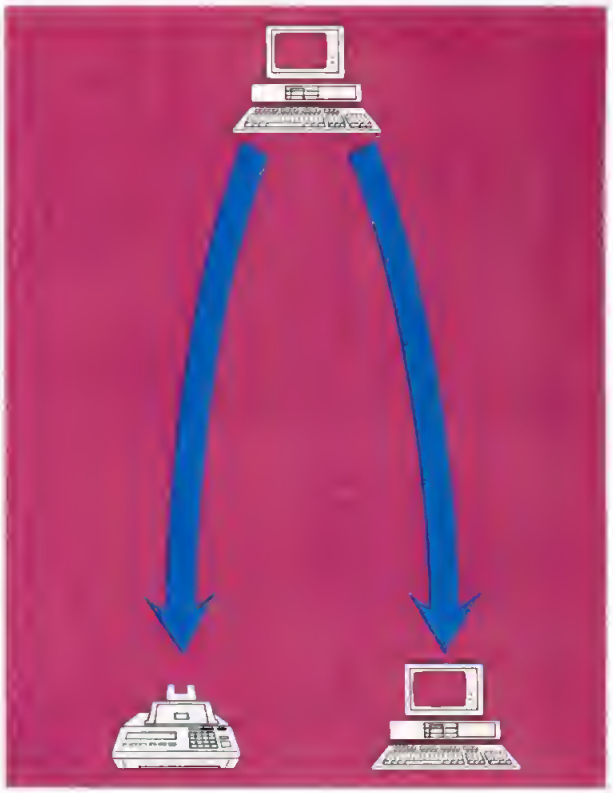
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CIRCLE 512 ON READER SERVICE CARD

■ WINN L. ROSCH ■ PC LAB NOTES

CHOOSING A HARD DISK AND CONTROLLER

Megabytes and money are only the first choices you have to make when you buy a new hard disk. Top performance depends on making the right marriage of disk and controller.

Getting the best hard disk upgrade for your PC is more than a matter of scanning the ads for the lowest price. Doing the job right requires carefully matching the disk drive to your computer and to yourself.

The hard disk that you choose depends on your wants, your needs, your computer, and your budget. You probably want everything possible—the most megabytes, the most speed, the easiest system to plug in. The power and performance of your computer will limit how many of these dreams you can turn into reality. Some computers make upgrading relatively easy. Others complicate matters. And your budget will determine whether such an upgrade project is feasible at all.

For the purposes of this article, I'll make a couple of assumptions. First, you want to install your new hard disk inside the chassis of your computer rather than in an external chassis. External hard disk drives almost universally arrive prefabricated as kits that make all the upgrading judgment calls for you. Second, I will assume that you don't want to opt for a hard disk card. These, too, are easy answers to the problem but they're often a more expensive solution.

COMPATIBILITY CONCERNS Once you've decided on an internal hard disk upgrade, the first step is easy: you must determine what size drive will fit inside your system's drive bays. Although you can adapt a physically smaller drive such as a 3½-inch unit to fit in a standard 5¼-inch drive bay, you'll need to find an adapter kit. Going the other way, putting the bigger drive into the smaller bay of a PS/2, is obviously impossible. And, if you're stacking one drive on top of another, it would be wise to check that "half-height" means the same thing to the drive manufacturer and to the maker of your machine. Little inconsistencies like this can mean a lot.

No less important, your new disk drive must also physically and electrically match the controller already installed in your computer. If it doesn't, you must plan on getting a new controller to match the new drive.

In most hard disk systems, the disk itself and its controller are separate parts. Some drives, however (the hard disks used in the PS/2 Models 30-286 and 70, for example), use embedded controllers, in which the control circuitry is contained on the disk drive rather than being mounted on a separate card. This won't save you a slot, however; to use an embedded-controller drive in a more conventional PC, you'll still need a separate electronic assembly called a "host adapter" to connect the drive to your system.

When upgrading your system with a more typical hard disk (one that does not have an embedded controller), the question of whether you can use the controller you already own or whether you must replace it depends also on the kind of machine you have. The AT, for instance, makes matters easy. Through its Setup program (included on a disk that accompanied your IBM computer or encoded into the BIOS of many compatibles) you can select the capacity of the hard disk you want to use with some freedom.

On the other hand, you can't simply plug a new hard disk into an XT with the same abandon as with an AT. The controller for the hard disk in an XT is designed to operate with a single disk configuration, a 10MB drive. The settings that your system needs to know about the hard disk are hard-coded into the ROM firmware on the disk controller. Without changing that

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■ PC LAB NOTES

ROM chip—or the entire controller—you're stuck with using a disk of the same size and layout as was originally supplied with your XT.

PCs and late-model hard-disk-less XTs make the decision about whether to buy a new controller still easier. You absolutely must get a controller with whatever hard disk you buy.

As a general rule, with a PC or XT you'll be best advised to buy a combination package—a hard disk sold with its own controller. AT-style and 80386-based systems generally require only a new disk drive. However, if you're planning an exotic upgrade—a truly huge hard disk or an extremely fast one based on newer interface technology, for example—you'll need a new controller for your AT-style or 80386-based system, too.

Recent Compaq machines present special problems of their own, which are discussed in the sidebar "Compaq Controllers: An Exception to the Rules."

Most of the hard disk controllers on the market support two drives. While this allows you to add a second drive to your system without the need for a second controller, you still face the need to match the second drive to the controller.

Primitive controllers, such as that of an XT, require that both drives have the same capacity and layout (number of heads and cylinders). More-modern XT-style controllers make allowance for different disk drive types by encoding setup information on the disk itself instead of in firmware. These controllers will usually accommodate two drives of different capacities. AT-class controllers similarly allow for a second drive of a different capacity.

If you want to upgrade an original IBM PC to hard disk performance, you'll also have to worry about the capacity of your power supply. PCs don't have enough power to run a hard disk without risking unpredictable failures, such as the system stopping dead in its tracks without warning. Therfore, if you want to add a hard disk to an original IBM PC, you will also want to upgrade the power supply of your computer to at least 100 watts, and preferably to 135 watts.

DISK CONTROLLERS Selecting a controller for a new hard disk is no easy matter. You have your choice of three *interfaces*: ST506, ESDI, and SCSI. And the most common of these three—the ST506—gives you a further selection among three methods of data coding.

The data coding methods commonly used by the ST506 interface are called MFM (modified frequency modulation), RLL (run length limited), and ARLL (advanced run length limited). Both the interface and the data coding system must match the design and capabilities of the hard disk you choose.

Let's consider the interfaces first. In one sense, the *interface* is simply the place in the electrical circuitry of your computer system at which the hard disk drive is connected to the controller. More precisely, the interface is a specification that defines the signals that must pass between the controller and hard disk. These signals include both the digital data and the control information that tells the hard disk where the data is or where it should go.

The ST506 interface is the industry's "Old Faithful." It actually predates the PC, and nearly every hard disk manufacturer has products that use it. Except for a few high-performance PS/2s, all IBM personal computers use the ST506 interface for their hard disks.

COMPAQ CONTROLLERS: AN EXCEPTION TO THE RULES

If you own a late-model high-performance Compaq computer—specifically a Deskpro 386/25 or Deskpro 386/20e—you don't have to worry about the issues of standard interfaces and matching disk drives to your computer. That's because off-the-shelf drives simply won't work with the controllers Compaq sells with these machines.

While the Compaq disk drives in these computers use standard ESDI and ST506 interfaces (the latter enhanced in some cases with RLL recording), Compaq has elected to allocate the electrical functions between the drive and its controller card in a nonstandard way. In addition, some of the connectors used do not match those that are otherwise standard in the hard disk industry.

On the positive side, the Compaq original-equipment drives offer exemplary speed. You won't ordinarily consider replacing a Compaq drive for something quicker. As long as you're satisfied with the standard storage in your Compaq system, you won't have to worry about the unusual interface.

On the other hand, if you want to replace your Compaq hard disk or to add a second drive to your system, the proprietary interface spells trouble. You can use only another Compaq drive with the standard-equipment Compaq controller, and genuine Compaq drives are less likely to be found at bargain prices than off-the-shelf equivalents.

The only alternative you have to buying drives directly from Compaq is to replace both the existing drive *and* its controller with industry-standard products. If you opt for this strategy, you'll be stuck with paying not only for an additional controller but also for an old Compaq hard disk that cannot be operated by your new industry-standard controller.

Although the proprietary Compaq controller-and-disk combinations offer advanced features courtesy of their advanced interfaces, 1:1 interleave support, and on-board buffering, *none* of these benefits requires the interface changes Compaq made. In fact, the only people who benefit from the nonstandard design are those who can keep their prices artificially high in selling new equipment, replacement parts, and upgrades.

—Winn L. Rosch

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The ST506 interface was conceived when hard disks were still in their infancy and their electronics relatively unrefined. A disk drive designed for the ST506 interface is dumb. It knows how to spin its platters and move its head, but it doesn't know anything about the data it stores or even how that data is stored.

Information is read from and written to the disk as a series of pulses that are turned into magnetic fields by the read/write head of the disk. The exact stream of pulses read from the disk is transferred directly as a serial data stream to the controller. On the controller, special circuits—known collectively as the "data separator"—make sense out of the pulses. The data separator determines which pulses constitute the actual information stored on the disk and which pulses identify sector locations on the disk.

The speed at which the pulses are transferred to the controller is determined by how many magnetic flux transitions are stored on every turn of the disk and how fast the disk spins. These parameters were standardized to yield a raw data transfer rate of 5 MHz between the disk and controller.

Other signals that flow through the ST506 interface tell the hard disk where to move its head, whether to read or write, and which of up to four disks connected to the controller is supposed to follow these orders. All the signals of the ST506 interface are routed through two cables—a 36-connection control cable and a 20-connection data cable.

ESDI CONTROLLERS The ST506 interface worked well—at least until higher speed computers began to spin their wheels waiting for an ST506 disk to spin off the data they wanted. At that point groups of manufacturers got together to hammer out new disk controller standards. These collaborations produced ESDI as an improvement on the basic ST506 concept and SCSI as the result of a rethinking of the way peripherals should be connected to a computer.

ESDI, the Enhanced Small Device Interface, was the work of over 40 manufacturers who banded together in the early '80s to lay out a new small computer interface to supersede ST506. Designed into ESDI are a number of special, desirable features that had emerged since the ST506 interface had won acceptance. Among these is a data transfer rate that can be set by the hard disk itself rather than by the controller. Transfer speeds of about 5 to 15 MHz are possible under the new interface standard.

ESDI also incorporates self-contained defect-mapping. That's to say, ESDI allows the defect maps—the locations of bad tracks on the disk—to be stored on the drive like other data, although the maps are designed to be accessible only to the controller.

■ SCSI operates at a higher level than do ST506 and ESDI, which are designed as device-level connections.

Further, ESDI moves the data separator from the controller onto the drive. Instead of sending raw data—the MFM pulses from the disk—to the controller, an ESDI drive and controller communicate in NRZ (not-return-to-zero) code. This helps ensure better data integrity.

As with ST506, ESDI still uses a 36-connector control cable and a 20-connector data cable, but the signals on most of the individual wires of the cables are different. The two interfaces are not compatible. Although you can physically plug an ESDI drive into an ST506 controller (or vice versa), the cross-species pairing won't work.

SCSI CONNECTIONS While ESDI requires a separate controller, much like that of ST506, the SCSI interface locates all the traditional controller functions on the hard disk drive itself.

SCSI operates at a higher level—the system level—than do ST506 and ESDI, which are designed as device-level connections. Indeed, SCSI is designed to be used for more than just hard disk connections. It's a general purpose standard. In effect, SCSI is more like an expansion bus than a device interface.

Speaking precisely, then, the board you plug into your PC to connect it with a SCSI hard disk is not a controller. All traditional controller functions are built into the disk drive itself. The SCSI board that you plug into your PC is properly termed a "host adapter"; it adapts the SCSI bus to the expansion bus of your computer.

Even for an expansion bus, SCSI is advanced. As with IBM's Micro Channel architecture, SCSI features a system of "bus arbitration," which allows different devices connected to the bus to take control. This ability allows data to be transferred between the various devices attached to a SCSI connection and share information without the intervention of the computer host. For instance, a SCSI tape drive can back up a SCSI hard disk while the computer to which they are connected is doing something else.

The SCSI system uses hardware arbitration—eight dedicated signal lines—to determine which devices get control of the bus. The standard allows for seven devices plus the computer host to be connected to one SCSI circuit. ST506 and ESDI support four devices per controller circuit.

The SCSI standard also includes a language that can be used to control the devices connected to the bus. For example, SCSI commands allow the motors of devices connected to the bus to be spun up sequentially, so when you turn your computer system on it isn't subjected to the massive current surges of seven motors trying to start up at once.

SCSI deals with data in blocks rather than as sectors or clusters on a hard disk. Being a higher level interface, it has to accommodate a wide variety of devices that may not have the same physical and logical layout as a hard disk.

This block-orientation complicates matters when it comes to connecting a SCSI hard disk to a PC, however. The commands that DOS issues to disk drives are based on disk sectors. They must thus be translated by a host adapter into SCSI block form before they can be passed along to a SCSI hard disk. SCSI host adapters vary considerably in the speed at which they can make this translation. Ac-



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JUDGING A HARD DISK'S SPEED

Manufacturers typically measure the speed of a hard disk in two ways. The first, access time, looks at the physical performance of the disk's motor and read/write components. The second, transfer rate, considers how much data is moved to the PC. A third kind of measurement, data throughput, is the only measure that really matters to you, however.

Average access time indicates how long it takes the drive to find a block of data on the disk. It measures the length of time required for the read/write head in the disk drive to move between two random tracks on the disk. A lower average access time is better.

The average access time depends, for the most part, on the type of head actuator used by the disk drive. Old-fashioned and slow hard disks use band-stepper controllers, an open-loop system. Better and faster drives use closed-loop servo head actuators based on voice-coil technology.

Real-world average access times range from 150 milliseconds to 15 ms., for the quickest drives. XT-quality hard disks are generally rated at about 80 ms.; AT hard disks, 40 ms. The PC Labs BIOS Disk Seek benchmark test reports the actual access time.

Data transfer rate measures the speed at which information is transferred between your hard disk drive and your computer. This speed is measured in megahertz (millions of bits per second) or megabytes per second, one-eighth the megahertz rate.

Real-world data transfer rates currently fit within a tight range that is between 5 and 10 MHz. Even this range is misleading, however. The data transfer rate given in hard disk specifications indicates only roughly the performance you can expect. It is a raw figure that will indicate the capabilities of a hard disk-and-controller combination under ideal circumstances.

Data throughput measures how much information actually gets from disk memory to the RAM of your computer where it can be put to work. Several factors combine to reduce the raw data transfer rate of a hard disk down to an often-much-lower data throughput rate. The way the hard disk is low-level formatted, the coding method used for storing data on the disk, the DMA and microprocessor performance of the computer host, and the bus structure of your computer all affect throughput performance. In many cases, these factors will prevent a drive with a higher data transfer rate from moving information any faster in a given computer. Throughput is tested by the PC Labs DOS File Access benchmark tests.

Obviously, a hard disk need not produce information any faster than a computer can use it, and an XT-class computer is beyond its limits handling the information from even an ordinary 5-MHz-transfer-rate hard disk drive. Most 80386-based computers, on the other hand, can benefit from the extra performance of 10-MHz drives.

—Winn L. Rosch

tual products may vary by a factor of five in transfer speed because of the conversion overhead. As a result the throughput you get from a given SCSI drive varies with the host adapter choice. This need for translation makes the true average access time of the hard disk itself essentially invisible to your computer.

As with most computer buses, the SCSI bus transfers signals in parallel, 8 bits at a time. These parallel transfers endow SCSI with higher speed potentials. Current systems operate at rates of 1.5 megabytes per second, asynchoronously. A more advanced, synchronous form of SCSI promises to increase that rate to 4 megabytes per second.

These speeds represent the rates at which the SCSI bus operates, however, not the actual data transfer rate of the devices connected to it. Most SCSI hard disks actually transfer data at a 10-MHz rate, a speed fixed by the data density on the drive and the rate of rotation of its disks. The 1.5-megabyte-per-second rate represents the maximum realizable transfer rate of any device at the present time. As with any other interface, actual throughput will vary with the device. For further discussion of the various factors that enter into the speed of a hard disk, see the sidebar "Judging a Hard Disk's Speed."

DATA CODING Because both the ESDI and SCSI standards put the data separator on the hard disk drive itself, these interfaces are insulated from the method used to code the actual magnetic flux transitions on the disk. The ST506 interface, however, passes the disk-generated pulses directly to the controller, so the arrangement of these pulses becomes an important consideration.

The most common data coding method used by hard disk is MFM. In the MFM scheme of things, a flux transition in the magnetic medium on the hard disk indicates a digital 1; a digital 0 is indicated by the lack of a flux transition within the given period in which one would be expected. (An extra flux transition is always inserted between consecutive 0s.)

The physical and temporal spacing of flux transitions on a disk are limited by the magnetic qualities of the disk and by the control electronics of the system. If the flux changes occur too closely, the read/write head will not be able to distinguish between them. Further, if they're too far apart, they can't be detected reliably. Thus, the density at which data can be stored is limited.

One important characteristic of MFM is that it operates at the bit level. That is, data is encoded in bit-size pieces by the flux transitions on the disk. The alternative is called "group-coding," a technique in which a collective pattern of bits—a group—is stored as a pattern of flux transitions. In this method, the number of bits and the number of flux transitions used to store the bits need not be the same.

That's the key to RLL data coding. In its most common form, under RLL each incoming byte is assigned a new code pattern 16 bits long. Although using more flux transitions for a given amount of data

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may seem like a rather perverse way of stretching the capacity of a hard disk, it does work. The trick is that only a fraction of the possible 16-bit patterns of flux transitions are required to store all the possible 8-bit patterns of data. The ones used by RLL are those that are easiest to record magnetically. In the most-used form of RLL, the principal requirement of the flux transitions on the disk is that the data they code must separate each logical 1 with a series of 0's. The actual number of zeros used to separate each logical 1 may range from two to seven, hence the formal name of 2,7 RLL.

■ AT-style systems encourage adding disk drives while retaining your existing controller.

2,7 RLL makes better use of the recording medium because it allows data bits to be coded to flux changes three times more densely. Only the digital 1's cause flux changes, and these are always spaced at least three binary places apart. Thus, although the 2,7 RLL code doubles the number of bits needed to encode data, the flux transitions can be squeezed three times closer together on the disk while maintaining the same spacing as would be produced by MFM. In this way, 2,7 RLL achieves 50 percent greater storage density than what is possible with MFM. Since the spin rate of the disk is unaffected by the data coding method used, the data transfer rate of the disk also increases by 50 percent.

Advanced RLL, sometimes termed ARLL or 3,9 RLL, works like 2,7 RLL but requires that there must be between three and nine 0's between each 1 in the expanded data code. ARLL allows flux transitions to be squeezed four times closer together while still only doubling the size of the code words. As a result, 3,9 RLL offers a potential doubling of disk capacity.

RLL encoding would *seem* to offer a cheap way to upgrade your existing hard disk system. Can't you just pop in a new RLL controller and turn your old 10MB drive into a 15MB—or even a 20MB—unit? Many users, and even a few manufacturers, have tried this, and the results—often a complete, irrecoverable loss of all data 6 months down the line—have unjustly cast doubts on the reliability of RLL encoding itself. To take advantage of either RLL technique, you need more than a new disk controller that can generate its special bit-patterns. You also need a disk drive that has tighter mechanical tolerances than are required for conventional MFM, and one whose electronics have the bandwidth required to handle the RLL data. Don't just trust that an MFM drive from a reputable manufacturer will meet the more stringent RLL requirements. If you're going to use an RLL controller, make sure the drive you intend to use is certified for RLL operation.

THE SETUP STEP Once you've got a disk and controller, the next step is setting them up in your computer. XT-style systems are easy because they are proprietary. They're bought as matched pairs, and all should come with explicit instructions on the proper connections and procedures.

The flexibility of AT-style systems encourages adding disk drives while retaining your existing controller. In this case, you simply need to know several parameters about your hard disk to properly set up your system. These parameters include the number of read/write heads in the disk drive, the number of cylinders, and at what cylinder write compensation comes into play (if at all). You just check the drive-type table associated with your computer and, after finding the drive type number assigned to your new hard disk, type the number at the appropriate prompt during the setup procedure. A discussion and chart of the IBM drive number assignments is contained in the sidebar "What the Hard Disk Drive Numbers Mean."

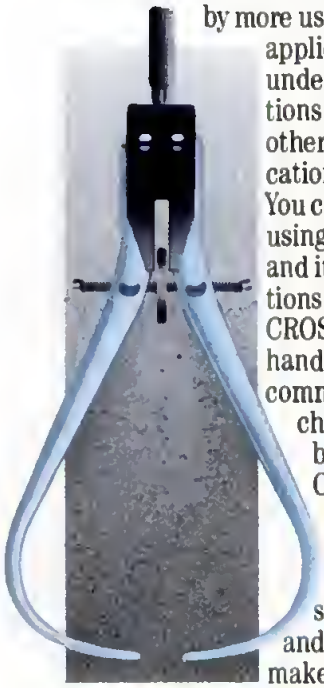
The big complication arises from the fact that no computer has an exhaustive drive-type table. Early ATs supported only 14 drive configurations. Later machines and PS/2s do only somewhat better. Thus, you may get a drive with a different number of heads or cylinders than your computer knows how to handle. In that case you have two alternatives: give up

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■ PC LAB NOTES

WHAT THE HARD DISK DRIVE NUMBERS MEAN

Before you can install a new hard disk drive in most computers you need to know the disk's drive number assignment. This is an arbitrary number that conveys particular information about the hard disk to your computer's BIOS. Unfortunately, there is only partial standardization of these arbitrary disk drive number assignments. Most compatible manufacturers follow IBM's numbering scheme up to type 15; some of the manufacturers follow it as far as 19.

Many manufacturers list the assignment details in the computer's setup program or documentation. Once you have located the drive-type number of your new hard disk, simply enter it at the appropriate prompt during the setup procedure.

Figure A shows IBM's assignments; don't automatically use these numbers for non-IBM PCs unless you've made certain the manufacturer faithfully follows IBM's scheme.

As you can see, there's no clear pattern to the drive number assignments. Some of the terms you'll come across are the following:

■ Cylinder: An imaginary construct formed by joining comparably numbered tracks on the drive's parallel circular magnetic platters.

■ Head: The electromagnetic read/write device that detects/imposes flux transitions on the magnetic medium. A disk with four heads has four magnetic surfaces, or platters.

■ Write Precomp(ensation): The cylinder number at which the heads increase the level of electrical current to compensate for losses in the inner tracks of the platter. Flux transitions are more widely spaced on the longer tracks at the outside of the circular platter and need no additional compensation.

■ Landing Zone: The cylinder at which the heads are parked.

■ Capacity: The number of megabytes of storage a disk can handle when matched with its intended controller. A disk matched with the wrong controller will hold less data.

You should note that capacities based on ESDI drives have 34 sectors per cylinder; other drives usually have 17 sectors per cylinder. RLL capacities can be higher.—**Winn L. Rosch**

IBM Drive Number Assignments

Type	Cylinders	Heads	Write Precomp	Landing Zone	Capacity (megabytes)	
1	306	4	128	305	10	
2	615	4	300	615	21	
3	615	6	300	615	32	
4	940	8	512	940	65	
5	940	6	512	940	49	
6	615	4	None	615	21	
7	462	8	256	511	32	
8	733	5	None	733	32	
9	900	15	None	901	117	
10	820	3	None	820	21	
11	855	5	None	855	37	
12	855	7	None	855	52	
13	306	8	128	319	21	
14	733	7	None	733	44	
15	0	0	None	0	0	
16	612	4	All	663	21	
17	977	5	300	977	42	
18	977	7	None	977	59	
19	1,024	7	512	1,023	62	
20	733	5	300	732	32	
21	733	7	300	732	44	
22	733	5	300	733	32	
23	306	4	None	336	10	
24	612	4	305	663	21	
25	306	4	None	340	10	
26	612	4	None	670	21	
27	698	7	300	732	85	[ESDI]
28	976	5	488	977	85	[ESDI]
29	306	4	All	340	10	
30	611	4	306	663	42	[ESDI]
31	732	7	300	732	89	[ESDI]
32	1,023	5	None	1,023	89	[ESDI]

Figure A: *The IBM type numbers above tell your PC what kind of hard drive you're installing. If you are using a non-IBM machine, you must check to see if the manufacturer follows IBM's type designations. The assignment details of your PC may be listed in the setup program.*



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some capacity or give up some money.

By foregoing some capacity, you can make most disk drives work with most computers. Simply check the drive-type table of your computer and find the drive parameters that come closest to the hard disk that you have, erring on the short side. That is, choose a drive type with the same or fewer heads and the same or fewer cylinders. Although the heads and cylinders in excess of the number given for the drive-type specification will not be used on your drive—a 40MB drive may yield only 37MB for instance—at least it will work with your system.

The other alternative is to invest in hard disk setup software. The two leading programs are *Disk Manager* (from Ontrack Computer Systems) and *SpeedStor* (from Storage Dimensions). These programs allow you to use the full capacity of your hard disk. They work by loading new drive type information into your computer through software that you store on your hard disk. In addition, these programs also give you the low-level formatting utility that IBM made you pay extra for with its pre-PS/2 computers.

In many cases, your floppy disk drives will also enter the setup picture. The floppy disk controller in AT-style computers and most 80386 machines is part of the hard disk controller. If you replace the controller in your AT, you'll need to replace its floppy-disk-controlling abilities as well.

With a new controller, you might not have to worry about the floppy connection because many—but hardly all—replacement AT-class controllers include floppy disk circuitry. You're not likely to get a floppy controller on a SCSI adapter, however.

You may be able to retain your old combined floppy-and-hard-disk controller in your AT to simply run your floppy disk drive by canceling out its hard disk section. Assuming that your new controller allows you to do so, you simply indicate in the setup procedure that no hard disks are installed. If this work-around does not work, however, you'll have to find a single-purpose floppy controller as a replacement.

Once all the connections are made and you've run the setup procedure (if your computer requires it), you're ready to low-level format, partition, and DOS format your new hard disk. The new or replacement drive works just like any other, only it should deliver more speed and greater capacity—and make you happier with your PC investment. PC

Winn L. Rosch is a contributing editor of PC Magazine.

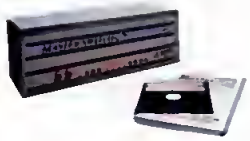


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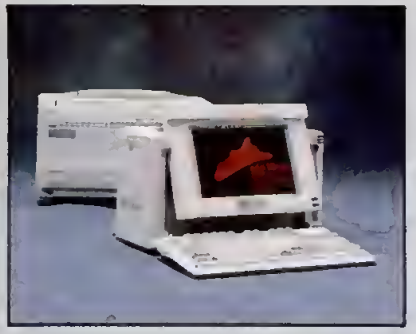
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"The Portacomp II is a value leader with memory, a fast drive controller and a terrific keyboard ...Marvelously cheap, powerful alternative...outperformed the other 286's." (Oct. 11, 1988)

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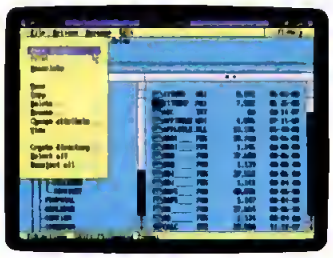
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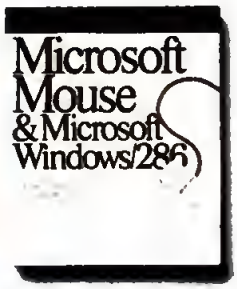
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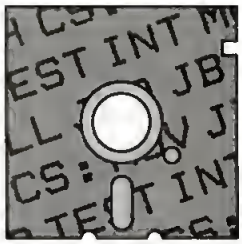
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SLICE OVERSIZE FILES DOWN TO FLOPPY SIZE



When your file is bigger than your floppy, SLICE and SPLICE let you split that file across a number of disks and then reassemble it on another machine.

It never fails. The file you have to copy onto the computer in the conference room just won't fit on a floppy. The machine there has a different version of DOS, so you can't use BACKUP and RESTORE to split the file between two diskettes. The meeting's already started and they need that file. Now.

After today, you'll be ready for such an emergency. You'll have a copy of SLICE, a utility that lets you spread a single file over as many as 99 diskettes. SLICE puts a copy of its companion program, SPLICE, onto the first diskette, so don't worry about being able to reassemble the pieces at the other end. And SLICE works with all removable media, from the ancient 160K floppies to the PS/2's 1.44MB diskettes. Indeed, SLICE can even handle removable disk cartridges.

When SLICE breaks up your single large DOS file, it creates a series of small output files stored successively in the root directories of the target media. At the same time, SLICE creates SPLICE.COM, which it stores on the first diskette. SPLICE restores only the specific file that SLICE has just split. After exhausting the free space on the first diskette, and after each succeeding diskette is filled, the program prompts for the next diskette.

To run SLICE, you simply need to know the name of the file to be split and have enough formatted diskettes (or other removable disk media) on hand to hold its pieces (plus SPLICE.COM). Obviously, the last diskette will probably not be filled completely. While the SLICE.COM program is only about 1,500 bytes long, you must have approximately 34K of free memory, since SLICE uses a 32K buffer and needs some stack space.

GETTING SLICE You can download a ready-to-run copy of SLICE.COM from PC MagNet, as explained in the sidebar, "SLICE by Modem." Alternatively, you can create the .COM file either from the SLICE.ASM source code or from SLICE.BAS, both of which are listed here and are also available via PC MagNet. The former alternative requires that you have a macro assembler (IBM or Microsoft, Version 2 or later) and that you enter

```
MASM SLICE;
LINK SLICE;
EXE2BIN SLICE SLICE.COM
DEL SLICE.EXE
DEL SLICE.OBJ
```

If you don't have a macro assembler, just run SLICE.BAS in BASIC once and you'll generate the same .COM file.

The SLICE command syntax is

```
SLICE [d:][path]filename[.ext] d:
```

The *filename* is the name of the file to be broken up and may include the drive and path. The other required parameter, *d:*, must be the letter of a drive that DOS can recognize as a removable medium. This is done via a DOS IOCTL (function 44h, subfunction 08h) call, whose documentation is shown in Figure 1. With normal diskettes this presents no problems; the device drivers for a few unusual drives might need to be modified, as explained below.

As indicated, SPLICE.COM, the restore program created when SLICE splits a file, is stored on the first of the target media. Although it is only about 1K in length, in order to run SPLICE, you'll again need

Checking for Removable Media
A DOS IOCTL Call

On entry	Register contents
AH	44h
AL	08h—Is device removable?
BL	Drive number (0=default, 1=A, 2=B, 3=C, etc.)
On return	**Register contents**
AX	00h if device is removable
	01h if device is fixed
	0Fh if the value in BL is invalid

Figure 1: *This call lets SLICE determine if a device supports removable media. The drive number should be placed in BL. If a zero is returned in AX, then the device is removable.*

■ UTILITIES

approximately 34K of free memory. Obviously, you'll also need a drive that can read the media on which SLICE has stored the broken file and enough hard disk storage space to contain the entire file that SPLICE is going to recreate.

The complete syntax of the SPLICE command is as follows:

`d:\SPLICE s: [t:][path]`

The *d:* parameter is the letter of the drive that contains the SPLICE program. The *s:* entry is the source drive for the split file. Normally, the drive letter you enter for *s:* will be the same letter you enter for *d:*, as the first sections of the file will be on the same diskette as the SPLICE program..

Finally, the optional *t:* and *path* parameters designate the drive onto which the file is to be restored. If none are specified, the file will be restored to the current direc-

```
                PAGE    78,122
                TITLE   "SLICE - break file for multiple diskettes"

CSEG            SEGMENT PARA PUBLIC 'CODE'
                ASSUME  CS:CSEG, DS:CSEG, ES:CSEG, SS:CSEG

; ---------------------------------------------------------------------------
;   DTA structure for DOS "find matching" call
; ---------------------------------------------------------------------------
                ORG     80H                     ; dta offset
DTA             DB      21 dup (0)              ; start of find file area
DTA_ATTR        DB      0                       ; file attribute
DTA_TIME        DW      0                       ; file time
DTA_DATE        DW      0                       ; file date
DTA_LSIZ        DW      0                       ; file lsw of size
DTA_MSIZ        DW      0                       ; file msw of size
DTA_NAME        DB      12 DUP (0)              ; file name of file
DTA_LEN         EQU     $-DTA                   ; length of dta find entry

                ORG     100H                    ; start of program area
START:          JMP     MAIN                    ; go to the code

; ---------------------------------------------------------------------------
;   Common initialized work areas
; ---------------------------------------------------------------------------
ARG             DW      0                       ; addr of first argument
FLOPDRV         DB      0,":\"                  ; output drive letter
DESTFILE        DB      "           ",0         ; output file name
DESTEST         DW      0                       ; pointer to extension
DESTEXTC        DB      "0"                     ; 1st character of extension
DESTNBR         DW      1                       ; file extension counter
RSTFLAG         DB      0                       ; slice/restore flag
CURRDIR         DB      ".",0                   ; argument for current directory
IHANDLE         DB      0                       ; input file handle
OHANDLE         DB      0                       ; output file handle

; ---------------------------------------------------------------------------
;   Messages to user
; ---------------------------------------------------------------------------
HEADER_MSG      DB      "SLICE   1.0 - (C) 1989 Biff Communications Co.",0DH,0AH
                DB      "PC Magazine ",294," Bob Flanders & Michael Holmes",0AH
                DB      0DH,0AH
DOLLAR          DB      "$"
FILENF          DB      "File not found$"
NOCREATE        DB      "Error opening output$"
NOROOM          DB      "Not enough room$"
WRONGDISK       DB      "Wrong restore disk, insert number "
DISKNO          DB      "XX$"
DRVNR           DB      "Must be removable media$"
RDERROR         DB      "Error reading input$"
WRTERROR        DB      "Error writing output$"
FILEFND         DB      "File exists$"
NEXTDISK        DB      "Next diskette$"
HITANYKEY       DB      ", Press any key ..",0DH,0AH,"$"
FORMAT          DB      0DH,0AH,"Format:",0DH,"$"
RSFORM          DB      "SPLICE   d:  d:[\path]",0DH,0AH,"$"
RESTORING       DB      "Restoring: "
RESTFILE        DB      12 DUP (" "),0DH,0AH,"$"

; ---------------------------------------------------------------------------
;   File ID Header
; ---------------------------------------------------------------------------
RSTLAST         DB      0                       ; last file flag
RSTATTR         DB      0                       ; file attributes
RSTTIME         DW      0                       ; file time
RSTDATE         DW      0                       ; file date
RSTLSIZ         DB      0                       ; file lsw of size
RSTMSIZ         DB      0                       ; file msw of size
RSTNAME         DB      12 DUP (0)              ; file name of file
RST_FFLEN       EQU     $-RSTATTR               ; length to move from ff area
RSTDATE         DD      0                       ; date ..
RSTSTME         DD      0                       ; ..and time of save
RST_LEN         EQU     $-RSTLAST               ; length of our file header

; ---------------------------------------------------------------------------
;   MAIN - Mainline of program
; ---------------------------------------------------------------------------
MAIN            PROC                            ; start of program
                CMP     RSTFLAG, 0              ; q. restoring?
                JNZ     RESTORE                 ; a. goto restore section

                CALL    INIT                    ; initialize program
                CALL    PARMS                   ; check parameters
                CALL    OPEN                    ; open the input file
                CALL    SAVE                    ; copy/slice the file to output
                JMP     SHORT MAIN10            ; return to dos

RESTORE:        CALL    INIT                    ; perform restore setup
                CALL    PARMS                   ; check parameters
                CALL    ROPEN                   ; open the output file
                CALL    RFILE                   ; restore the file

MAIN10:         MOV     DX, OFFSET DOLLAR       ; dx -> null message
                CALL    DIE                     ; .. say goodnight
MAIN            ENDP

; ---------------------------------------------------------------------------
;   INIT - Handle initialization
; ---------------------------------------------------------------------------
INIT            PROC
                CLD                             ; ensure ascending
                MOV     DX, OFFSET HEADER_MSG   ; dx -> header message
                MOV     AH, 9                   ; ah = print ascii$ message
                INT     21H                     ; .. ask DOS to do it
                RET                             ; return to caller
INIT            ENDP

; ---------------------------------------------------------------------------
;   ROPEN - open the file to restore
; ---------------------------------------------------------------------------
ROPEN           PROC
                MOV     DI, OFFSET ROPENFILE    ; di -> work area
                MOV     SI, ARG                 ; si -> where to restore

ROPEN10:        MOVSB                           ; move a character

                CMP     BYTE PTR [SI], 0        ; q. end of parm?
                JNE     ROPEN10                 ; a. yes .. continue

                CMP     BYTE PTR [DI-1], "\"    ; q. last byte a back-slash?
                JE      ROPEN20                 ; a. yes .. continue

                CMP     BYTE PTR [DI-1],":"     ; q. last byte a colon (drive)?
                JE      ROPEN25                 ; a. yes .. continue

                MOV     AL, "\"                 ; add as directory
                STOSB

ROPEN20:        MOV     SI, OFFSET RSTNAME      ; si -> name of original file
                MOV     BX, OFFSET NEXTFILE     ; bx -> restore filename

ROPEN30:        LODSB                           ; al = char of filename
                STOSB                           ; .. save it

                OR      AL, AL                  ; q. end of file name?
                JE      ROPEN40                 ; a. yes .. continue

                MOV     [BX], AL                ; save in message
                INC     BX                      ; bx -> next char
                JMP     ROPEN30                 ; .. continue

ROPEN40:        MOV     AH, 4EH                 ; ah = find first
                MOV     DX, OFFSET ROPENFILE    ; dx -> file to find
                MOV     CX, 0FFH                ; .. any attribute
                INT     21H                     ; q. file found?
                JC      ROPEN45                 ; a. no ., continue

                MOV     DX, OFFSET FILEFND      ; dx -> file already exists
                CALL    DIE                     ; .. push up some daisies

ROPEN45:        MOV     AH, 2CH                 ; ah = create function code
                MOV     CL, RSTATTR             ; cx = original attributes
                XOR     CH,CH                   ; .. upper byte off
                INT     21H                     ; issue DOS call
                JNC     ROPEN50                 ; if no problems, continue

                MOV     DX, OFFSET NOCREATE     ; dx -> create error message
                CALL    DIE                     ; .. go deep six

ROPEN50:        MOV     OHANDLE, AX             ; save the file handle

                MOV     DX, OFFSET RESTORING    ; dx -> restore message
                MOV     AH, 09H                 ; ah = print ascii$
                INT     21H                     ; .. tell the user

                RET                             ; return to caller
ROPEN           ENDP

; ---------------------------------------------------------------------------
;   RFILE - restore file
; ---------------------------------------------------------------------------
RFILE           PROC
                CALL    NEXTFILE                ; create a file name

RFILE10:        MOV     DX, OFFSET FLOPDRV      ; dx -> file name
                MOV     AH, 3DH0H               ; al = open for read
                INT     21H                     ; .. ask DOS to do it.
                JNC     RFILE20                 ; nk .. continue

RFILE15:        MOV     DX, OFFSET WRONGDISK    ; dx -> wrong disk message
                CALL    HITKEY                  ; .. display and wait
                JMP     RFILE10                 ; .. and try again

RFILE20:        MOV     IHANDLE, AX             ; save file handle

                MOV     BX, AX                  ; bx = handle
                MOV     AH, 3FH                 ; ah = read file
                MOV     CX, RST_LEN             ; cx = len to read
                MOV     DX, OFFSET BUFFER       ; dx -> buffer to read
                INT     21H                     ; read a buffer
                JC      RFILE30                 ; tell 'em we cant read it

                MOV     SI, BX                  ; si -> buffer
                MOV     DI, OFFSET RSTLAST      ; di -> our header
                MOVSB                           ; move last flag, setup for compare
                MOV     CX, RST_LEN-1           ; cx = bytes to check
        REPE CMPSB                              ; q. headers the same?
```

(continues)

SLICE.ASM: *The source code for the SLICE.COM, a utility that lets you copy a file that's too big to fit on a single floppy disk to multiple diskettes. SLICE makes it easy to transfer larger files from one computer to another.*

No matter which of these modes you use,

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■ UTILITIES

```
                JE      RFILE30                 ; e. yes .. continue

                MOV     AH, 3EH                 ; eh = close file
                INT     21H                     ; close output file
                JMP     RFILE15                 ; tell 'em

RFILE30:        MOV     AH, 03FH                ; eh = read file
                MOV     BX, IHANDLE             ; bx = handle of file to read
                MOV     CX, BUFLEN              ; cn = amount to read
                MOV     DX, OFFSET BUFFER       ; dx -> buffer
                INT     21H                     ; read, please
                JNC     RFILE40                 ; if no error .. continue
RFILE35:        MOV     DX, OFFSET RDERROR      ; dx -> read error message
                CALL    DIE                     ; ..and die gracefully

RFILE40:        MOV     CX, AX                  ; cn = bytes to write
                JCXZ    RFILE80                 ; if finished .. exit loop

                MOV     AH, 40H                 ; ah = write
                MOV     BX, OHANDLE             ; bh = output file handle
                INT     21H                     ; write a buffer
                JC      RFILE50                 ; error .. die

                CMP     AX, CX                  ; q. able to write it?
                JE      RFILE30                 ; e. as .. tell 'em

                MOV     DI, OFFSET NOROOM       ; dl -> wontfit msg
                JMP     SHORT RFILE60           ; ..and exit gracefully

RFILE50:        MOV     DI, OFFSET WRTERROR     ; di -> write error message

RFILE60:        MOV     AH, 41H                 ; ah = delete function
                MOV     DX, OFFSET ROPENFILE    ; dx -> filename
                INT     21H                     ; issue DOS call

                MOV     DX, DI                  ; dx -> error message to give
                CALL    DIE                     ; ..make my day, punk!

RFILE80:        MOV     AH, 3EH                 ; ah = close file
                INT     21H                     ; close output file

                CMP     RSTLAST, 0              ; q. end of file
                JE0     RFILE90                 ; e. no .. continue

                MOV     DX, OFFSET NEXTDISK     ; dx -> next disk message
                CALL    HITKEY                  ; display message and wait
                JMP     RFILE                   ; .. get next file

RFILE90:        RET                             ; else .. return to caller
RFILE           ENDP

; ---------------------------------------------------------------------------
;   NEXTFILE - Build next filename
; ---------------------------------------------------------------------------
NEXTFILE        PROC
                MOV     AX, DESTNBR             ; AX = current count
                AAA                             ; AX = almost ascii nbr
                OR      AX, 3030H               ; AX = ascii values
                XCHG    AL, AH                  ; swap bytes for store
                MOV     BX, DESTEXT             ; bx -> 2nd char of extension
                MOV     [BX], AX                ; store rest of extension
                MOV     WORD PTR DISEND, AX     ; .. and in message
                INC     DESTNBR                 ; increment for next time
                RET                             ; ..and return to caller
NEXTFILE        ENDP

; ---------------------------------------------------------------------------
;   HITKEY - Allow user to change diskettes; dx -> first message
; ---------------------------------------------------------------------------
HITKEY          PROC
                MOV     AH, 9H                  ; ah = print string
                INT     21H                     ; .. call dos to print message

                MOV     DX, OFFSET HITANYKEY    ; dx -> prompt
                INT     21H                     ; issue prompt message

                MOV     AX, 0C08H               ; en = clear buffer, wait for key
                INT     21H                     ; issue DOS call

                OR      AL, AL                  ; q. function key hit?
                JE0     HITKEY90                ; e. no .. exit
                MOV     AH, 08H                 ; ah = wait for key
                INT     21H                     ; issue DOS call

HITKEY90:       RET
HITKEY          ENDP

; ---------------------------------------------------------------------------
;   PARMS - Parse the command line
; ---------------------------------------------------------------------------
PARMS           PROC
                CALL    UPCASE                  ; upper case the parm area
                MOV     SI, 81H                 ; si -> parms area

PARMS10:        LODSB                           ; get parameter character

                CMP     AL, 0DH                 ; q. end of line?
                JE      PARMS50                 ; e. yes .. exit
                CMP     AL, " "                 ; q. blank?
                JNA     PARMS10                 ; e. yes .. skip
                CALL    ARGCHK                  ; get the argument
                JC      PARMSERR                ; .. die on no error

PARMS30:        LODSB                           ; get next character
                CMP     AL, 0DH                 ; q. end of line?
                JE      PARMS50                 ; e. yes .. process
                CMP     AL, " "                 ; q. end of PARMS?
                JA      PARMS30                 ; e. no .. next char

                MOV     BYTE PTR [SI-1], 0      ; end the parameter
                JMP     PARMS10                 ; .. look for next

PARMS50:        MOV     BYTE PTR [SI-1], 0      ; end the parameter

                CMP     ARG, 8                  ; q. PARMS 1 available?
                JBE     PARMS60                 ; e. no .. error

                CMP     RSTFLAG, 0              ; q. restoring?
                JE      PARMSERR                ; e. no .. error
                MOV     ARG, OFFSET CURRDIR     ; arg -> current directory

PARMS60:        CMP     FLOPDRV, 0              ; q. Drive given?
                JE      PARMSERR                ; e. no .. error else

                RET                             ; .. else .. return to caller

PARMSERR:       MOV     DX, OFFSET FORMAT       ; dx -> format message
                MOV     AH, 09H                 ; ah = print ascii$
                INT     21H                     ; hey DOS .. print it!

                MOV     DX, OFFSET RSFORM       ; dx -> restore format

                CMP     RSTFLAG, 0              ; q. restore?
                JNZ     PARMSERR1               ; e. yes .. die now

                MOV     DX, OFFSET SFFORM       ; dx -> slice format

PARMSERR1:      CALL    DIE                     ; .. play taps
PARMS           ENDP

; ---------------------------------------------------------------------------
;   ARGCHK - Setup pointers to command line args; si -> 2nd char in arg
;            Exit: ARG or FLOPDRV filled in; Carry set if > 2 args
; ---------------------------------------------------------------------------
ARGCHK          PROC
                LEA     BX, [SI-1]              ; bx -> argument

                CMP     RSTFLAG, 0              ; q. restoring?
                JE      ARG05                   ; e. as .. continue
                CMP     FLOPDRV, 0              ; q. drive filled in?
                JE      ARG20                   ; e. no .. fill it in

ARG05:          CMP     ARG, 0                  ; q. ARG filled in?
                JNE     ARG10                   ; e. yes .. check 2
                MOV     ARG, BX                 ; save ARG pointer
                JMP     SHORT ARG90             ; .. exit ok!

ARG10:          CMP     FLOPDRV, 0              ; q. drive filled in?
                JE      ARG20                   ; e. no .. fill it in
                STC                             ; else .. error
                RET                             ; .. and return to caller

ARG20:          MOV     FLOPDRV, AL             ; save drive
                MOV     SPLICEDRV, AL           ; .. in file and program names

                MOV     BL, AL                  ; bl = drive letter
                SUB     BL, "@"                 ; bl = drive number
                MOV     AH, 4408H               ; ax = ioctl, removable?
                INT     21H                     ; issue DOS call

                OR      AL, AL                  ; q. removable media drive?
                JS      ARG90                   ; e. yes .. return

                MOV     DX, OFFSET DRVNR        ; dx -> error message
                CALL    DIE                     ; issue non-removable message

ARG90:          CLC                             ; show no error
                RET                             ; return to caller
ARGCHK          ENDP

; ---------------------------------------------------------------------------
;   UPCASE - Convert command line arguments to uppercase
; ---------------------------------------------------------------------------
UPCASE          PROC
                PUSH    SI                      ; save caller regs
                PUSH    DI
                MOV     SI, 81H                 ; si -> start of parm area
                MOV     DI, SI                  ; .. same for di
                CLD                             ; .. ensure ascending

UPCASE10:       LODSB                           ; al = char
                CMP     AL, 0DH                 ; q. end of line?
                JE      UPCASE90                ; e. yes .. end of line!
                CMP     AL, "a"                 ; q. is it below 'a'?
                JE      UPCASE20                ; e. yes .. continue
                CMP     AL, "z"                 ; q. is it above 'z'?
                JA      UPCASE20                ; e. yes .. continue
                SUB     AL, 20H                 ; set to upper case

UPCASE20:       STOSB                           ; save the byte
                JMP     UPCASE10                ; .. and continue

UPCASE90:       POP     DI                      ; restore caller regs
                POP     SI
                RET                             ; .. end return to caller
UPCASE          ENDP

; ---------------------------------------------------------------------------
;   DIE - Display an error message and return to DOS; dx -> ascii$ error msg
; ---------------------------------------------------------------------------
DIE             PROC
                MOV     AH, 9H                  ; ah = print string
                INT     21H                     ; .. call dos to print error

                MOV     BX, IHANDLE             ; bx = input file handle
                OR      BX, BX                  ; q. file opened?
                JS      DIE90                   ; e. no .. try output file
                MOV     AH, 3EH                 ; ah = close file
                INT     21H                     ; .. ask DOS to do it

DIE90:          MOV     BX, OHANDLE             ; bh = output file handle
                OR      BX, BX                  ; q. file opened?
                JE      DIE95                   ; e. no .. just exit

                MOV     AH, 3EH                 ; ah = close file
                INT     21H                     ; .. ask DOS to dx it

DIE95:          MOV     AX, 4C88H               ; ax = exit
                INT     21H                     ; .. terminate routine
DIE             ENDP


RESTLIMIT       EQU     $                       ; only need up to here

; ---------------------------------------------------------------------------
;   Slice only areas and messages
; ---------------------------------------------------------------------------
```

(SLICE.ASM continues)

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CIRCLE 226 ON READER SERVICE CARD

■ UTILITIES

```
SPFORM      DB      "SLICE     [d:\path\]filename[.ext] "
            DB      " d:",$DN,$AN,$AM,"$"
$EROLEN     DB      "Input file empty",$Da,$AN,"$"
NOCOM       DB      "Progrse won't fit",$Da,$AN,"$"
aFLICSDRV   DB      "x:\"
$FLICE      DB      "$FLICH.COM",$

; ---------------------------------------------------------------------------
;   OPEN - Opens neat file to procaaa; Carry indicates file would sot open.
; ---------------------------------------------------------------------------
OPEN        PROC
            MOV     DX, ARG                 ; dx -> file name
            MOV     AM, 3D$$H               ; al = open for raad
            INT     21H                     ; .. aak DOS to dx it.
            JC      OPEN$5                  ; ok .. continue

            MOV     IHANDLE, AM             ; aava file handla

            MOV     AH, 4NH                 ; ah = find flrat
            MOV     Da, ARG                 ; dx -> file to find
            XOR     Ca, Ca                  ; cx = aaarch attributa
            IET     21H                     ; q. find first file ok?
            JMC     DPEN1$                  ; a. yea .. continua

DPEN$5:     MOV     DX, OFF$ST FILENF       ; dx -> file not found
            CALL    D1E                     ; .. gaap your final hraath

OPEN10:     MOV     AX, DS:DTA_LEIS         ; an = law af aiaa
            OR      AM, DS:DTA_AMIS         ; q. any dxta?
            JMX     OPEN9$                  ; a. yea ..contisoa

            MOV     Da, OFFSET $EROLEN      ; dx -> file cnotains no dxta
            CALL    DI$                     ; .. dxarly baloved ...

OPEN90:     RET
OPEN        ENDP

; ---------------------------------------------------------------------------
;   SAVE - Handla building allca filaa on destlnation
; ---------------------------------------------------------------------------
SAVE        PROC
            CALL    BLD_RESTORE             ; build raatora progrse

SAVE10:     MOV     A$, $3FH                ; ah = raad fila
            MOV     Ba, IHANDLE             ; ha = handla of fila to raad
            MOV     Ca, BUFLEN              ; cx = amount to raad
            MOV     Da, OFF$ET BUFFEN       ; dx -> buffar
            IET     21$                     ; raad, plaaaa
            JNC     $eVE2$                  ; if no arror .. continua
            MOV     DX, DFFSET RDERROR      ; dx -> rand arror maaaaga
            CALL    DIE                     ; ..and dia gracafully

SAVH20:     CALL    WRITE                   ; ..and write out a baffar full
            JC      seve$$                  ; lf finiahed .. aait loop
            JMP     $AVE1$                  ; alaa .. gat naxt buffar

Save9$:     RET                             ; raturn to callar
SAVE        ENDP

; ---------------------------------------------------------------------------
;   BLD_R$STORE - Build the raatora program
; ---------------------------------------------------------------------------
BLD_RESTORE PROC
            MOV     AH, 2AH                 ; ah = gat data function call
            INT     21H                     ; iaaua DOS call

            MOV     WORD PTR $OTEDTE, CX    ; aava yaar
            MOV     WORD PTR AHTEDTE+2, DX  ; ..and month and day

            MOV     AH, 2CH                 ; ah = gat time function call
            INT     21$                     ; iaaua DOS call

            MOV     WORD PTR RSTSTME, CX    ; aava hours and minutaa
            MOV     WORD PTR RSTSTME+2, DX  ; ..and saconds and hundradths

            MOV     SI, OFFSET DTA_APTR     ; ai -> source atring
            MOV     DI, OFFSET RSTAPTR      ; di -> aava area
            MOV     CX, RST_FFLEN           ; cx = langth to move
      REP MOVSB                             ; copy atring

            MOV     DI, OFFSET HEADEN_MSG   ; di -> progrse name
            MOV     SI, OFFSET SPLICE       ; ai -> raatora progrse name
            MOV     CX, 7                   ; cx = langth
      ANF MOVSB                             ; .. matup progrse name

            MOV     SI, OFFSET DTA_NAME     ; ai -> source file name
            MOV     DI, OFFSET DNSTFILN     ; di -> work file name
            MOV     Ca, $                   ; ax = langth to move

BLD_RE$T10: LODSB                           ; al = char from filaname

            CMP     AL, ","                 ; q. and Of filaname?
            JZ      BLD_RE$T30              ; a. yaa .. axit loop
            OR      AL, AL                  ; q. and of atring?
            JS      BLD_AME$T20             ; a. yaa .. axit loop

            STOSB                           ; aava character
            LOOP    BLD_AME$T10             ; ..and loop tlll and of atring

BLD_AME$T20: MOV    AL, "."                 ; aaaara file saparator char
BLD_RE$T30: STOSB                           ; aava the aaparator

            MOV     DESTEXT, DI             ; aava pointer to file axtanaina

            CMP     BYTE PTR [SI-1], "."    ; q. Wha axtanaion faund?
            JNH     BLD_AME$T32             ; a. so .. allow dxfault

            LODSB                           ; gat lat char aftar axtanatina
            MOV     DESTEXTC, AL            ; ..and aava for latar

BLD_REST32: MOV     $OTFLAG, 1              ; aat raatora flag

            MOV     AL, DESTEXTC            ; al = lat char of axtanaion
            MOV     DI, HS$TEXT             ; dl -> poaltion in filaname
            STOSB                           ; aava lat character
            MOV     DeSTENT, DI             ; aava pointer to 2nd char

BLD_RE$T35: MOV     DX, DFFSET SPLICEDRV    ; dx -> SPLICE nrogrse name
            CALL    CREATE                  ; craata tha naw fila
            POSH    WORD PTR FLOPDRV        ; aave drive parameter
            PUSH    ARG                     ; .. and ARG
            MOV     FLOPDRV, $              ; xara ..
            MOV     ARG, $                  ; .. them out

            MOV     AH, 40H                 ; ah = write function code
            MOV     CH, OFFSET AMNTLIM1T    ; cx = langth to move
            MOV     DX, OFFSET START        ; dx -> atart af progrse
            SUB     CX, D$                  ; .. forgat tha PSP
            INT     21H                     ; iaaua DOS call

            POF     ARG                     ; raatora ..
            POF     WORD PTR FLOPDRV        ; .. parametara
            JC      BLD_REST4$              ; if ak, continua

            CMF     AR, CX                  ; q. all af pga gat out?
            JN      BLD_REST5$              ; a. yaa .. continua

BLD_RE$T48: MOV     A$, 3EH                 ; ah = clasa function
            INT     21$                     ; close fila

            CALL    DELETE                  ; dxlata output fila
            MOV     Da, OFFSNT NOCOM        ; dx -> no room at the inn
            CALL    HITENT                  ; ..iaaua aaaaaga
            JMP     BLD_AME$T35             ; ..and try with a naw diskatta

BLD_RE$T50: MOV     AH, 3EH                 ; ah = clasa fila
            INT     21H                     ; .. aah DOS to dx it

            RET                             ; return to callar
BLE_RESTORE ENDP

; ---------------------------------------------------------------------------
;   WRITE - Writa a fila magmant; ax = nbr af bytaa to write ($ if EOF)
;                   Hait: Carry aat if EOF procaaaing complata
; ---------------------------------------------------------------------------
WRITE       PROC
            MOV     $X, OHANDLE             ; hx = handla number
            MOV     CX, AH                  ; q. anything to write?
            JCaZ    WRITE5$                 ; a. no .. EOF requaat

            MOV     Da, OFFSET BUFFEH       ; dx -> atart of baffar
            OR      Ba, Ba                  ; q. handla open?
            JNa     WRITE4$                 ; a. yaa .. cantinua

WRITE$5:    PUSH    Ca                      ; aava length
            PUSa    Da                      ; ..and buffar addraaa
            CALL    NEXTFILE                ; build extanaima for naxt fila

WRITE10:    MOV     Da, OFFSNT FLOPDRV      ; dx -> file to craata
            CALL    CREATE                  ; apan naw fila

            MOV     OHANDLE, $X             ; aava fila handla
            MOV     CX, AMT_LEH             ; cx = langth of haadar
            CALL    HOWNUCH                 ; update raaaiving disk apaca
            MOV     AH, 40H                 ; ah = write file function
            MOV     DH, OFFSET RSTLAST      ; dx -> our fila haadar
            INT     21H                     ; iaaua DOS call
            JNC     WRITE2$                 ; if no arror .. continua

            MOV     DX, OFFSNT WRTERROR     ; dx -> arror maaaaga
            CALL    D1H                     ; ..than display and dia

WRITE20:    CMP     AH, CX                  ; q. write out all of haadar?
            JE      WRITE3$                 ; a. yaa .. continua

            MOV     AH, 3E$                 ; ah = clasa function
            INT     21H                     ; iaaua DOS call
            CALL    DELETE                  ; dxlata naw fila

            MOV     DX, OFFSET NOROOM       ; dx -> naxt diak maaaaga
            CALL    HITKEY                  ; iaaua maaaaga and wait
            JMP     WRITE1$                 ; ..try to gat naxt file

WRITE3$:    POP     DX                      ; raatora ragiatara
            POP     CX                      ;

WRITE40:    CALL    HOWNUCH                 ; gat haw much to write

            MOV     AH, 40$                 ; ah = write fila
            IET     21H                     ; iaaua DOS call
            JNC     WRITE45                 ; dia ao any arror

            MOV     D$, OFFSNT WRTERROR     ; dx -> gamaral arror mag
            CALL    DIH                     ; iaaua mag and tarminata

WRITE45:    ADD     DX, AH                  ; dx -> aext buffar addraaa
            MOV     CX, DI                  ; cx = ramainder af bytaa to write
            JCa$    WRITE4$                 ; if so mora, axit

            PUSH    DX                      ; aava buffar addraaa
            MOV     AH, 3EH                 ; ah = clasa functima
            IET     21H                     ; iaaua DOS call
            MOV     Da, OFFSNT NEXTDISH     ; dx -> naxt diah maaaaga
            CALL    HITKEY                  ; display maaaaga and wait
            POP     DX                      ; .. raatora buffar addraaa
            JMP     WRITE0$                 ; ..thao gat naxt fila

WRITH4$:    CLC                             ; claar carry for callar
            RET                             ; ..and raturn

WRITE50:    OR      $X, $X                  ; q. handla open?
            JZ      WRITE6$                 ; a. no .. continua

            MOV     AX, 4200H               ; ah = poaition fila
            XOR     CX, CX                  ; cx = fila poaition
            XOR     DX, DX                  ; dx = aab of fila poaition
            INT     21H                     ; poaltion to top of fila

            MOV     RSTLAST, 1              ; aat flag
            MOV     AH, 40$                 ; ah = write functina
            MOV     Ca, 1                   ; cx = langth
            MOV     DX, OFFSET $OTLAST      ; dx -> baffar
            INT     21H                     ; write aof markar in haadar
            MOV     AH, 3E$                 ; ah = close function
            INT     21H                     ; issua DOS call
```

(SLICE.ASM continues)



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■ UTILITIES

```
WRITE60:    STC                         ; set carry flag
            RET                         ; ..and return to caller
WRITE       ENDP

; ---------------------------------------------------------------------------
;   HOWMUCH - Calculate how much to write; CX = requested amount to write
;                                      Exit: CX = nbr of bytes which will fit
;                                            DI = remainder
; ---------------------------------------------------------------------------
HOWMUCH     PROC
            PUSH    DX                  ; save registers

            MOV     AX, WORD PTR AVAIL  ; get howmuch is available
            MOV     DX, WORD PTR AVAIL+2 ; . . . .
            MOV     DI, 0               ; assume everything will fit

            OR      DX, DX              ; q. more than 64k?
            JNZ     HOWMUCH80           ; a. no .. must be less than 64k

            CMP     CX, AX              ; q. enough room left?
            JNA     HOWMUCH80           ; a. yes .. use it all

            MOV     DI, CX              ; di = nbr requested
            SUB     DI, AX              ; di = remainder
            MOV     CX, AX              ; CX = nbr to write

HOWMUCH80:  SUB     AX, CX              ; ax = new available
            SBB     DX, 0               ; dx:ax = new available
            MOV     WORD PTR AVAIL, AX  ; store for later
            MOV     WORD PTR AVAIL+2, DX ; . . . .

HOWMUCH90:  POP     DX                  ; restore registers
            RET                         ; ..end return
HOWMUCH     ENDP

; ---------------------------------------------------------------------------
;   CREATX - Create new file; dx -> file to open
;                            Exit: bx = handle of opened file
; ---------------------------------------------------------------------------
CREATE      PROC
            MOV     BP, DX              ; save file name pointer

CREATE10:   MOV     AX, 36X             ; ah = get drive info
            MOV     DL, FLOPDRV         ; dl = drive letter
            SUB     DL, "@"             ; dl = drive number
            INT     21H                 ; get free space

            CMP     AX, -1              ; q. drive ok?
            JE      CREATE19            ; e. no .. next disk

            OR      BX, BX              ; q. any clusters available?
            JNZ     CREATE10            ; a. yes .. build new file
```

```
CREATE15:   MOV     DX, OFFSET NOROOM   ; dx -> no room at inn message
            CALL    BITKEY              ; get new diskette
            JMP     CREATE10            ; ..try again

CREDATE10:  BUL     BX                  ; dx:ax = nbr of sectors available
            MUL     CX                  ; dx:ax = nbr of bytes available
            BOV     WORD PTR AVAIL, AX  ; store howmuch is available
            MOV     WORD PTR AVAIL+2, DX ; . . . .

            MOV     AX, 4EB             ; ah = find first function code
            MOV     CX, 0FFB            ; cx = any attributes
            MOV     DX, BP              ; dx -> filename
            IBT     21H                 ; issue DOS call
            JC      CREATE20            ; if not available, create it

            MOV     DX, OFFSET FILEFND  ; dx -> file found message
            CALL    HITKEY              ; let user change diskette
            JMP     CREATE10            ; ..then try again

CREATE20:   MOV     AX, 3CB             ; ah = create function code
            XDA     CX, CX              ; cx = no (special) attributes
            INT     21E                 ; issue DOS call
            JNC     CREATX90            ; if problems, exit

            MOV     DX, OFFSET NOCREATE ; dx -> create error message
            CALL    DIE                 ; ..and die

CREATE90:   MOV     BX, AX              ; bx = handle
            RET                         ; ..and return to caller
CREATE      ENDP

; ---------------------------------------------------------------------------
;   DXLETE - Delete a file
; ---------------------------------------------------------------------------
DELETE      PROC
            MOV     AX, 41E             ; ah = delete function
            MOV     DX, OFFSET FLOPDRV  ; dx -> filename
            INT     21E                 ; issue DOS call

            RET                         ; ..and return
DXLETE      ENDP

; ---------------------------------------------------------------------------
;   Uninitialized data areas
; ---------------------------------------------------------------------------
UDATA       EQU     $                   ; start of initialized data
ROPENFILE   EQU     BYTE PTR UDATA      ; word area for ropen
AVAIL       EQU     DWORD PTR ROPENFILE+69 ; available output space
BUFFER      EQU     BYTE PTR AVAIL+4    ; file buffer
BUFLEN      EQU     22*1024             ; length of buffer

CSEG        ENDS                        ; end of code segment
            END     START
```

(SLICE.ASM ends)

```
100 REM - BASIC PROGRAM TO CREATE SLICE.COM
110 CLS:PRINT "Creating SLICE.COM    ": OPEN "SLICE.COM    " AS #1 LEN = 1
120 FIELD 41, 1 AS A$: CHECKSUM%=0
130 FOR I = 1 TO    99
140  LINESUM%=0: LOCATE 2,2: PRINT "Countdown: "    99 - I ;
150  FOR J = 1 TO  16: READ BYTE%: BYTE = VAL("&H" + BYTE%)
160   CHECKSUM% = CHECKSUM% + BYTE: LINESUM% = LINESUM% + BYTE
170   IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180  NEXT J
190  READ LINETOT%: LINECHECK4 = VAL("&H"+LINETOT$)
200  IF LINXCHECK4 = LINESUM4 THEN GOTO 220
210  LOCATE 4,2: PRINT "Error in line #"  I   260 + 10 * 2: GOTO 260
220 NEXT I
230 CLOSE: READ FILETOT% : FILECHECK% = VAL(FILETOT%)
240 IF CHECKSUM4 <> FILECHECK4 THEN GOTO 260
250 PRINT: PRINT "SLICE.COM     Created successfully": BYTE%EN
260 PRINT: PRINT "SLICE.COM     is not valid!": END
270 DATA E9,  A2,  1,  0,  0, 8E,  3A,  5C, 20, 20, 20, 26, 20, 20, 20,   222
280 DATA 20, 20, 20, 20,  0,  0,  0,  0, 20,  I,  0,  0, 2E,  0,  0,  0,   DF
290 DATA  0, 53, 4C, 49, 42, 45, 20, 20, 20, 21, 2E, 30, 20, 2D, 20, 20,  2F4
300 DATA 62, 29, 20, 21, 39, 20, 29, 20, 5A, 69, 66, 66, 20, 43, 6F, 6D,  479
310 DATA 6D, 79, 6E, 69, 62, 61, 74, 69, 6F, 6E, 72, 20, 42, 6F, 2E,  D,  987
320 DATA  A, 50, 43, 20, 4E, 61, 67, 01, 7A, 69, 6E, 65, 20, FE, 20, 42,  969
330 DATA 6F, 62, 20, 46, 6C, 61, 6E, 64, 69, 72, 72, 20, 26, 20, 4D, 69,  93C
340 DATA 62, 68, 61, 65, 6C, 20, 48, 6F, 6C, 6E, 65, 73,  A,  E,  A, 24,  4CA
350 DATA 46, 69, 6C, 65, 20, 6E, 6F, 74, 20, 66, 6F, 75, 6E, 64, 24, 45,  596
360 DATA 72, 72, 6F, 72, 20, 6F, 70, 69, 6E, 69, 6E, 67, 20, 6F, 75, 74,  64D
370 DATA 70, 79, 74, 24, 4E, 6F, 74, 20, 65, 6E, 6F, 79, 67, 68, 20, 72,  9E6
380 DATA 6F, 6F, 6D, 24, 97, 72, 6F, 6E, 67, 20, 72, 65, 72, 74, 6F, 72,  63E
390 DATA 69, 69, 79, 20, 2E, 2E,  D,  A, 24,  0,  A, 66, 6F, 72, 6D, 61,  42C
400 DATA 74, 3A,  9, 24, 93, 98, 4C, 49, 43, 49, 20, 20, 64, 3A, 20, 3B9
410 DATA 20, 64, 3A, 58, 5C, 78, 61, 74, 60, 9D,  H,  A, 24, 92, 69, 72,  4E4
420 DATA 74, 6F, 72, 69, 6E, 67, 3A, 20, 20, 26, 20, 20, 20, 20, 20, 20,  1XD
430 DATA 26, 20, 20, 20,  D,  A, 24,  0,  0,  0,  0,  0,  0,  0,  0,  0,   8E
440 DATA  4,  0,  0,  0,  0,  4,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,    8
450 DATA  0,  0,  0,  0,  0,  0, 8E, 2E, 1A,  1,  0, 79,  E, E8, 1D,  0, E8,  349
460 DATA 36,  1, E8, 6F,  2, E8, 9C,  2, E8,  C, E8,  F,  0, E8, 2A,  1,  619
470 DATA X6, 12,  0, E8, 6E,  0, BA, 7F,  1, E8, D8,  1, FC, BA, 21,  1,  728
480 DATA 84,  9, CD, 21, C3, 8F, 2D,  7, 8B, 36,  3,  1, A4, 8B, 3C,  0,  946
490 DATA 75, 7A, 8B, 7D, FF, 5C, 74,  9, 46, 7D, FF, 3A, 74,  3,  0, 8B, 9C, 7FD
500 DATA BA, EE, 91,  2, B8, 78,  2, AC, AA,  A, C8, 74,  9, 48,  7, 43,  698
510 DATA E8, F9, B4, 4E, BA, 2D,  7, 89, FF,  0, CD, 21, 72,  6, BA, 1A,  7C2
520 DATA  2, E8, 98,  1, 84, 2C, 8A,  E, 88,  2, 32, E0, CD, 21, 73,  8,  613
530 DATA BA, 8F,  1, E8, 7E,  1, A3, 1F,  1, BA, 6D,  2, B4,  9, CD, 21,  648
540 DATA C3, E8, 88,  0, BA,  9,  1, 88,  0, 3D, CD, 21, 73,  0, BA, B4,  68F
550 DATA  1, E8, 8F,  0, E8, EE, A3, 1D,  1, 88, D0, E4, 3F, E9, 1E,  8,  73F
560 DATA BA, 72,  7, CD, 21, 72, 24, 8E, F2, 8F, 87,  2, A4, 88, 1E,  8,  6F8
570 DATA F1, A6, 74,  6, 84, 1E, CD, 21, E8, D4, 84, 2F, 68, 1E, 1E,  1,  76C
580 DATA 89,  8, 88, 98, BA, 72,  7, CD, 21, 73,  8, BA, F1,  1, E8, 23,  71A
590 DATA  1, 88, C8, E3, 22, E4, 48, 8E, 1X, 1F,  1, CD, 21, 72,  9, 20,  58A
600 DATA C1, 74, D7, 8F, A4,  1, BA,  2, 8F,  9,  2, E4, 41, BA, 2D,  7,  7B7
```

```
690 DATA CD, 21, 8E, E7, E8, FD,  8, E4, 3E, CD, 21, 88, 2E, 87,  2,  8,   75C
700 DATA 75,  9, BA, 2E,  2, X8, 10,  8, E8,  76, FF, C2, A1, 1E,  1, 37,  675
710 DATA  E, 28, 28, 86, C4, 88, 1E, I5,  1, 89,  7, A3, D6,  1, FF,  6,  585
720 DATA 18,  1, C2, E4,  8, CD, 21, BA, 34,  2, CE, 21, E8,  8,  C, CD,  9FE
730 DATA 21,  A, C8, 79,  4, B4,  0, CD, 21, C2, E8, 9A,  0, 8E, 81,  8,  692
740 DATA AC, 3C,  D, 74, 10, 3C, 28, 76, F7, E8, 48,  0, 72, 2F, AC, 2C,  603
750 DATA  D, 74,  A, 3C, 20, 77, F7, C6, 44, FF,  8, EB, E2, C6, 44, FF,  819
760 DATA  8, 82, 3E,  3,  I,  8, 75,  E, 88, 2E, 1A,  1,  8, 74,  E, C7,  369
770 DATA  6,  3,  1, 1E,  I, 88, 2E,  5,  I,  6, 74,  1, C3, BA, 49,  2,  327
780 DATA 84,  9, CD, 21, BA, 94,  2, 88, 3E, 1A,  1,  8, 79,  2, BA, C5,  588
790 DATA  4, E8, 60,  0, 8D, 9C, FF, 88, 3E, 1A,  1,  0, 74,  7, 88, 2E,  546
800 DATA  9,  1,  8, 74, 16, 83, 2E,  2,  1,  0, 79,  6, 89, 1E,  2,  1,  27E
810 DATA EB, 23, 88, 3X,  5,  1,  8, 74,  2, X9, C2, A2,  5,  1, A2, 16,  564
820 DATA  9, 8A, D8, 60, BA, 40, 88,  0, 44, CD, 21,  A, C8, 74,  6, BA,  782
830 DATA D9,  1, E8, 1F,  8, F8, C3, 56, 57, BE, 81,  0, 8B, FE, FC, AC,  689
840 DATA 3C,  2, 74,  D, 3C, 61, 72,  8, 3C, 7A, 77,  2, 2C, 20, BA, X8,  4EF
850 DATA EE, 5F, 5X, C2, 84,  9, CD, 21, 8B, 1E, 1E,  1,  8, E8, 74,  4,  63E
860 DATA 84, 3E, CD, 21, 88, 1E, IF,  1,  8, DB, 74,  4, E4, 3E, CD, 21,  9E7
870 DATA 88,  8, 4C, CD, 21, 52, 4C, 49, 43, 49, 20, 20, 20, 20, 20, 58,  45D
880 DATA 64, 2A, 5C, 78, 61, 74, 68, 5C, 9D, 66, 69, 6C, 65, 6E, 61, 6D,  63C
890 DATA 69, 9E, 2E, 65, 78, 74, 5D, 20, 20, 64, 2A,  D,  A,  A, 24, 49,  488
900 DATA 6E, 78, 79, 74, 20, 66, 69, 6C, 69, 20, 69, 6D, 70, 74, 79,  D,  9E3
910 DATA  A, 24, 58, 72, 6F, 67, 72, 6X, 6E, 20, 77, 6F, 6E, 27, 74, 20,  939
920 DATA 66, 69, 74,  E,  A, 24, 70, 3A, 5C, 53, 98, 4C, 49, 42, 49, 2E,  47A
930 DATA 42, 4F, 4D,  0, 88, 16,  2,  1, E8,  0, 2D, CD, 21, 72,  F, A3,  488
940 DATA IE,  1, E4, 4E, 8E, I6,  2,  1, 33, C9, CD, 21, 72,  6, BA, 88,  562
950 DATA  I, E8, 60, FF, A1, 9A,  0,  E,  8, 5C,  0, 79,  6, BA, EF,  4,  650
960 DATA E8, 51, FF, C2, E8, 1F,  0, E4, 2F, 8B, 1E, 1E,  1, B9,  0, 80,  6F9
970 DATA 90, BA, 72,  7, CD, 21, 73,  6, BA, F1,  1, E8, 26, FF, E8, E1,  88C
980 DATA  8, 72,  2, EB, E2, C2, 84, 2A, CD, 21, 89,  E, 9D,  2, 89, 16,  6A5
990 DATA 9F,  2, E4, 2C, CD, 21, 89,  E, A1,  2, 89, 16, A3,  2, 8E, 99,  648
1000 DATA  0, BF, 80,  2, E9, 19,  0, F3, A4, BF, 21,  1, BE, 19,  9, 89,  624
1010 DATA  7,  8, F2, B4, EE, 9E,  0, EF,  0,  1, E9,  0,  0, AC, 2C, 2E,  999
1020 DATA 74,  9,  A, C8, 74,  2, BA, E2, F4, E8, 2E, BA, 89, 2E, 19,  1,  6A3
1030 DATA 80, 7C, FF, 2E, 79,  4, AC, A2, I7,  1, C6,  6, 1A,  1,  1, A8,  998
1040 DATA 17,  1, 8E, 2E, 19,  1, BA, 89, 2E, 15,  1, BA, 16,  9, E8, F7,  922
1050 DATA  8, FF, 26,  5,  1, FF, 36,  3,  1, C6,  6,  5,  1,  8, C7,  6,  413
1060 DATA  1,  0,  8, B4, 48, 89, C5,  4, BA,  0,  1, 2B, CA, CD, 21,  818
1070 DATA 8F,  6,  2,  1, 8F,  6,  5,  1, 72,  4, 3E, C1, 74,  F, B4, 2E,  418
1080 DATA CD, 21, E8, 10,  1, BA,  2,  5, E8, 8D, FD, EW, BE, B4, 3E, CD,  8AD
1090 DATA 21, C3, 88, 1E, 1F,  1, 8E, C8, E2, 65, BA, 72,  7,  E, IE, 79,  6D6
1100 DATA 19, 91, 92, E8, 86, FD, BA,  5,  1, E8, 9C,  8, 89, 1E, 1F,  1,  692
1110 DATA 89, IE,  0, E8, 6B,  8, E4, 40, BA, 87,  2, CD, 21, 73,  6, BA,  682
1120 DATA  5,  2, E8, 4F, FE, 2E, C1, 74,  F, B4, 2E, CD, 21, E8, C9,  8,  748
1130 DATA BA, A4,  1, X8, 6D, FD, E8, CE, 9A, 99, E8, 44,  8, E4, 40, CD,  98A
1140 DATA 21, 73,  6, BA,  5,  2, E8, 2B, FE,  3, D8, 8B, CF, E3,  E, 52,  6OC
1150 DATA B4, 2E, CD, 21, BA, 26,  2, E8, 49, FD, 5A, EB, A4, F8, C2,  8,  89F
1160 DATA DE, 74, 1C, 88,  0, 42, 33, C9, 33, D2, CD, 21, C6,  6, 87,  2,  6A8
1170 DATA  1, E4, 48, E9,  1,  0, BA, 87,  2, 2E, CD, 21, E4, 2E, CD, 21,  6B9
1180 DATA C3, 52, A1, 6E,  7, 88, 16, 78,  7, 8F,  8,  8, E2, 75,  A,  55E
1190 DATA 30, C8, 76,  6, 80, F9, 2B, F8, 8E, C8, 2B, C1, 02, DA,  0, A3,  865
1200 DATA 6X,  7, 89, 14, 78,  7, 9A, C1, 88, BA, 84, 36, 8A, 16,  9,  1,  5AD
1210 DATA 88, BA, 40, CD, 21, 2D, FF, FF, 74,  4,  8, D8, 75,  0, BA, A4,  80C
1220 DATA  1, E8, DF, FC, E8, X4, F7, X3, F7, EI, A2, 6X,  7, 89, 16, 78,  A6C
1230 DATA  7, 84, 4E, 89, FF,  0, 8E, D5, CD, 21, 72,  8, BA, IA,  2, E8,  747
1240 DATA C1, FC, EB, C6, E4, 3C, 33, C9, CD, 21, 73,  8, BA, 8F,  1, E8,  8F1
1250 DATA 82, FD, 88, D8, C3, E4, 41, BA,  9,  1, CD, 21, C2,  8,  0,  0,  70B
1260 DATA 148668
```

SLICE.BAS: *This BASIC program provides an alternative way to create the SLICE.COM utility if you'd rather not use a macro assembler.*

SLICE BY MODEM

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SLICE (and SPLICE) Command

Bob Flanders and Michael Holmes May 16, 1989 (Utilities)

Purpose: Distributes a DOS file that is too large to be copied onto a single floppy disk among multiple diskettes, enabling the file to be restored onto a second computer.

Format: `SLICE [d:][path]filename[.ext] d:`

Remarks: The *filename* of the file to be divided may be preceded by a drive and path. The *d:* target drive may be any drive that DOS recognizes as a removable medium. Diskettes from 160K to 1.44MB in capacity may be used, as may disk cartridges whose device driver identifies them as employing a removable medium.

As each target diskette becomes filled, the user is prompted to insert a fresh one; up to 99 formatted target disks can be accommodated. On the first of these, SLICE also creates a short (approximately 1K) program, SPLICE.COM, subsequently used to reassemble the separate sections into which *filename* has been broken. The syntax for SPLICE.COM is

Format: `d:\SPLICE s: [t:][path]`

Remarks: The *d:* parameter designates the drive on which SPLICE.COM has been written, and *s:* designates the source drive. Normally, these are the same. The optional *t:* and *path* identify the hard disk path onto which the file is to be reassembled as a single entity. If these latter parameters are unspecified, the default drive and directory will be used for restoration. The original *filename* cannot be changed in either the SLICE or SPLICE operation. Each of the operations requires approximately 34K of available memory.

Note: Although the DOS BACKUP and RESTORE utilities also permit a single file to be divided among multiple disks, they require the same version of DOS to be present on both the originating and the receiving machines.

SLICE.COM, its source code file, SLICE.ASM, and SLICE.BAS, a program that will automatically generate SLICE.COM when run once in BASIC, are available for downloading by modem from PC MagNet (see the "SLICE by Modem" sidebar).

■ UTILITIES

tory. Note that the name of the file you're working on cannot be changed during either the SLICE or SPLICE operation.

HOW SLICE WORKS Much of what SLICE does is fairly straightforward, so let's concentrate on a few of the tricks and the less-obvious parts of the code.

One of the first actions SLICE performs is a check of the parameters passed to the program. During this process, SLICE asks DOS if the output device is removable, using the DOS IOCTL call in Figure 1. While this is well covered in the DOS *Technical Reference* manual, you might make a note that a device driver must tell DOS that it's controlling a removable-media drive. Floppies, with which SLICE will presumably be used most of the time, will work just fine, but this requirement may have been overlooked in the case of some of the unusual drives on the market.

Assuming that all is well and good with the format of the parameters, SLICE next attempts to open the input file. If successful, a DOS Find File is performed against the file in order to determine its characteristics. These characteristics, together with the current date and time, are then moved into the data area set up by SLICE. This is where things get interesting.

■ SLICE is actually two programs rolled into one .COM file. The first program breaks up the files, and the second program restores them.

SLICE is actually two programs rolled into one .COM file. The first program breaks up the files, and the second program restores them. When SLICE executes, it immediately writes out a copy of the restore program onto the first target diskette under the filename SPLICE .COM. (We'll talk about how SPLICE works shortly.) Next, SLICE notes the space available on the output diskette, opens the output file, and, using the DOS configuration, copies the data to the target diskette in 32K sections or, if less than 32K remains available, in the largest section that will fit.

Filling a diskette using the DOS write function can be a bit confusing. If you read the DOS *Technical Reference* manual, you will find that a Write (DOS function 40h) returns the number of bytes actually written in the AX register. This would *seem* to indicate that DOS will write as many bytes



to the output device as will fit. Thus, for example, suppose you had 4K available on a diskette, and you performed a 6K write. You would expect the value 4K to be returned in AX, which would indicate that 2K did not make it to the output device. This is not so. If DOS cannot fit all of the bytes of a write request onto the output device, *no* data is written and a zero is returned in AX.

This seemingly minor point presents a difficulty when you are attempting to fill a diskette with a file. Since DOS will write either all or nothing, it becomes the job of the application program to note the amount of space available on the output drive and write only that number of bytes.

Thus, when it opens a new output diskette, SLICE notes the amount of space available and copies only the number of bytes that will fit onto that diskette. As each write occurs, the number of free bytes remaining on the diskette is checked and reduced by the number of bytes requested. When there is not enough space for a full 32K write, only the portion that will fit on the diskette is written, and the rest is held to be written on the next diskette.

■ If there is not enough space for a full 32K write, only the portion that will fit on the diskette is written; the rest is held for the next diskette.

As each diskette fills up, the output file is closed, a new diskette is requested, and another file is created. This cycle continues until the file has been completely written to the removable device.

When the end of file has been encountered on the input file, the SLICE program uses a DOS Move File Read/Write Pointer (function 42h) to move to the first byte of the output file and then write a nonzero byte, which indicates that it is the last part of the file.

As noted previously, SLICE writes the SPLICE.COM file before it proceeds to its main task. This is because SPLICE is wholly contained in the SLICE program. All of the common subroutines and initialized data areas required by SPLICE are contained in the first portion of the program. SLICE simply writes this area out to the SPLICE.COM file.

Before the SPLICE program is written, however, the information returned from the DOS Find File call is recorded in the common data area. SPLICE will use this

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EGA Compatible
640 x 350 pixels

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							VGA		Apple Mac II	1024 x 768 (48 kHz)	1280 x 1024 (64 kHz)
				NTSC	CGA	EGA	Std.	Ext.			
Diamond Scan 14 (AUM1381A)	14/13V	15.7 ~ 36 auto-tracking	0.31	•	•	•	•	•	•		
Diamond Scan 16L* (HL6605TK)	16/15V	30 ~ 64 auto-tracking	0.31				•	•	•	•	•
Diamond Scan 20A (HA3905ADK)	20/19V	15.7 ~ 38 auto-tracking	0.31		•	•	•	•	•		
Diamond Scan 20L* (HL6905TK)	20/19V	30 ~ 64 auto-tracking	0.31				•	•	•	•	•
XC1429C	14/13V	31.5	0.28				•				
XC1410C	14/13V	22 or 15.75	0.40		•	•					
XC1430C	14/13V	22 or 15.75	0.31		•	•					

*Microprocessor-enhanced programmable display settings

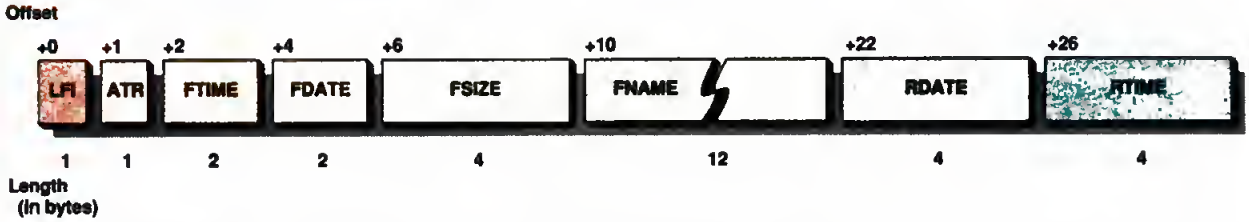
MITSUBISHI ELECTRONICS

And Value.

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CIRCLE 368 ON READER SERVICE CARD

How SLICE Keeps Track: A 30-byte Section File Header



Name	Description
LFI	Last File Indicator. This field is *zero* unless the current section file is the last one in the series. When this field is not zero, SPLICE interprets it as the last file to be restored.
ATR	File Attributes. This field through FNAME is returned by the DOS Find File function. This field represents the file's attributes.
FTIME	File Time. This is the last update time associated with the original file processed by SLICE.
FDATE	File Date. This is the last update date associated with the original file processed by SLICE.
FSIZE	File Size. This is the size, in bytes, of the original file.
FNAME	Filename. This is an ASCIIZ string (a string of ASCII characters followed by a byte of zeros) that is the name of the original input file.
RDATE	Run Date. This is the DOS date on which the file was SLICEd.
RTIME	Run Time. This is the DOS time at which the file was SLICEd.

Figure 2: *This 30-byte header is stored with each section into which SLICE divides the file and is used by SPLICE when restoring it.*

both to assure that the proper file is being restored and to restore that file with the correct attributes.

When SLICE is finished, the DOS file has been divided into sections from 1 to 100 that are suitable for restoration with SPLICE. Each of these sections has the same filename as the original file, but carries an extension composed of the first character from the original file's extension (zero if there was no extension originally) plus a two-digit counter indicating the section of the file it represents. Moreover, as diagrammed in Figure 2, each section has a 30-byte header that precedes the data from the original file.

UNDERSTANDING SPLICE Apart from a couple of interesting features, SPLICE is basically a very simple file-copy program.

When SLICE was executed, a DOS Find File was performed on the input data file and the characteristics of the file were recorded both in the SPLICE program and in the header of each file section created by SLICE. This information is used at restore time.

SPLICE starts, of course, by checking the parameters and issuing an appropriate error message if there is a problem. Next, it uses a DOS Find File to ensure that the file being restored does not already exist. If not, it creates the file to be restored and opens the first section file.

Before restoring any data, SPLICE reads in the header from the section file and checks to see that the information from the header is the same as that contained in the SPLICE program. If the information does not match, the program requests another diskette. If the information does match, the rest of the section file is copied to the output file. This cycle continues until the section file with the last file indicator is encountered.

One piece of code in the SLICE program that you may find useful in other applications is a simple three-instruction method for turning a hexadecimal value from 0h to 63h (0 to 99 decimal) into a two-digit ASCII number.

Assuming that the value that is to be converted is in the AX register, the following instructions will do the trick for you:

```
MOV BL, 10
DIV BL
OR  AX, 3030H
```

The result of these commands leaves the tens in AL and the units in AH. This makes AX suitable for moving the value into the message that is to contain it, since AL and AH are reversed when moved to memory. This code is used to generate the filename for the section file to be read or written next.

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Bob Flanders is president and senior systems analyst and Michael Holmes is vice president and senior systems analyst at NCI Systems in Annandale, Virginia.



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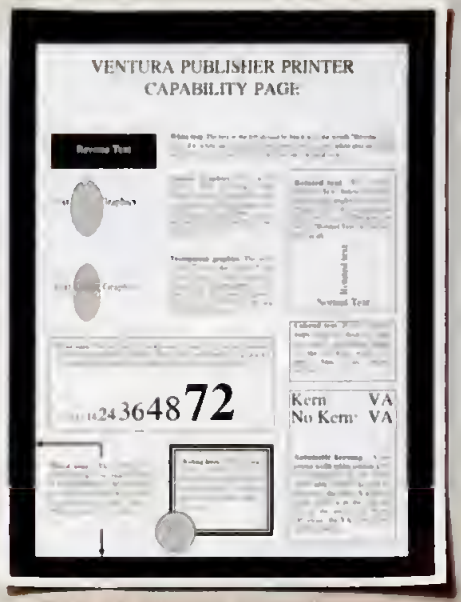
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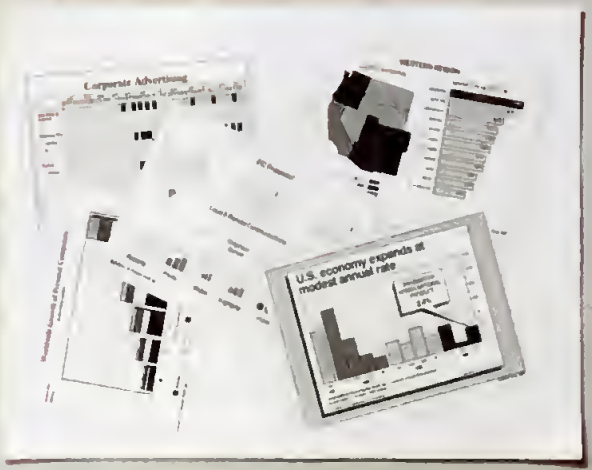
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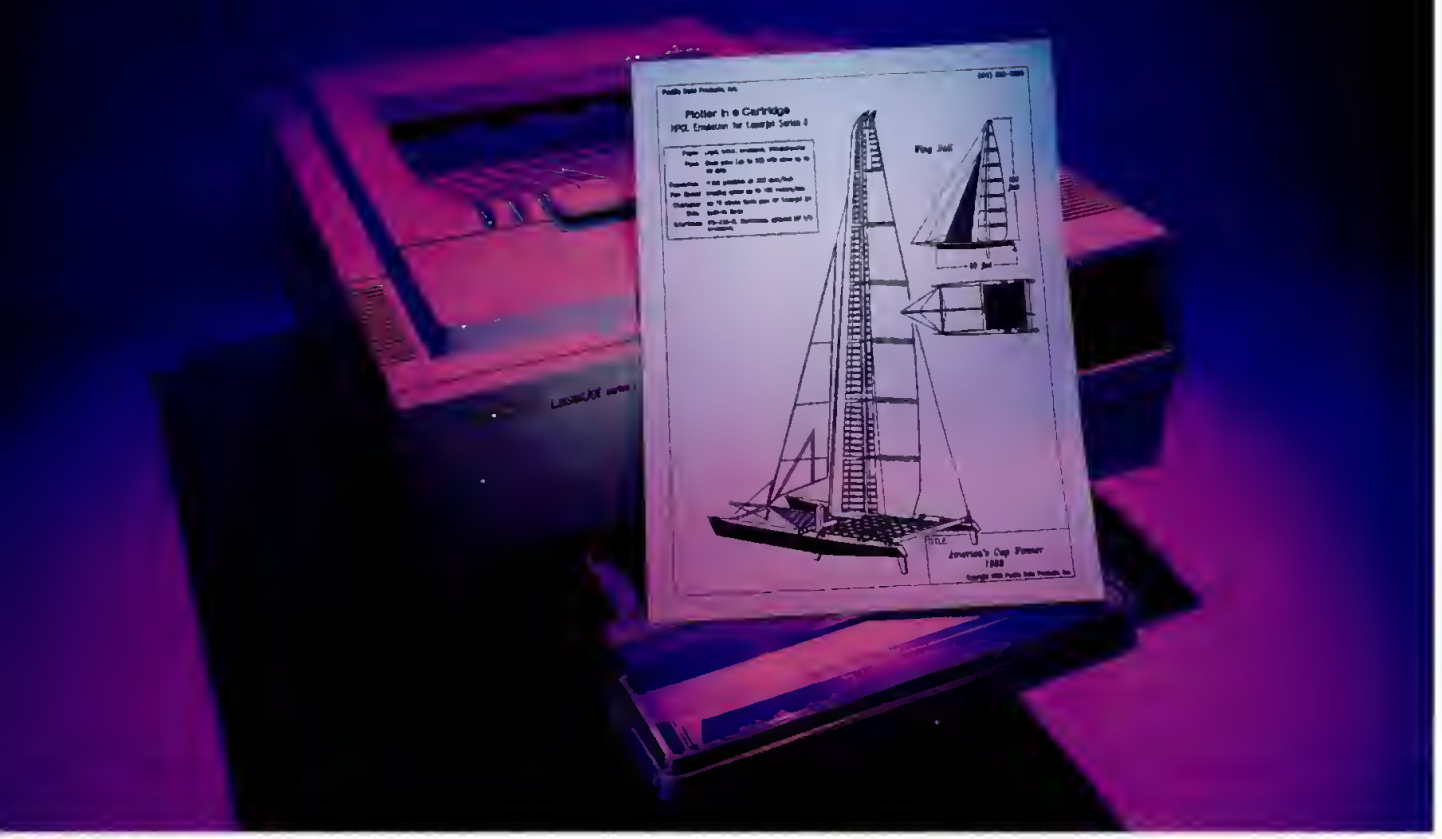
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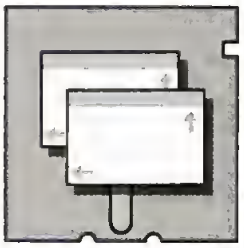
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■ ENVIRONMENTS ■ CHARLES PETZOLD

PM PROGRAMS AND NON-PM PROGRAMS



You can't use Presentation Manager's Graphics Programming Interface without adopting its message-based architecture. Understanding OS/2 program types shows you why.

Just as new car buyers are prone to "sticker shock," new Presentation Manager programmers often experience "API shock." Programming for the Presentation Manager can be pretty scary at first, and it never really becomes easy. There are hundreds of operating-system function calls, many new data types, and data structures to be defined in the Presentation Manager header files, and—most disconcerting of all—there's the strange, message-based, object-oriented system architecture.

Most of us learned to program in what is sometimes called top-down structure. This traditional program structure is relatively easy to learn because it requires very little overhead. It's easy to get started with the traditional "Hello, world" program and move forward by incrementally enhancing it.

As we've seen in past columns, however, Presentation Manager programs require considerably more overhead. The aspiring PM programmer must get past several major hurdles just to display a message like "Hello, world" in a Presentation Manager window.

REWARDS AND TEMPTATIONS Of course, the rewards of getting past these hurdles are considerable—there's a lot of really neat stuff in the Presentation Manager API. The Graphics Programming Interface (GPI) component of the Presentation Manager, for example, is one of the hottest graphics programming systems that was ever created.

But it's not surprising that some programmers would like to start using the neat stuff without dealing with the complexities of message-based architecture. "Can I use GPI without writing a PM program?" is a question I've heard again and again.

The answer is "Generally, no." Presentation Manager programming is usually an all-or-nothing proposition. As a rule, you can't use Presentation Manager functions in a non-PM program. Some people will find this answer frustrating. It's as if the operating system were designed on the principle that you can have ice cream for dessert only if you eat your spinach first.

You'll notice, however, that I qualified the first three sentences of the preceding paragraph. In fact, there's a whole collection of Presentation Manager functions that *can* be used in a traditionally structured non-PM program.

Toward the end of this column, I'll discuss the problems that would result if you could use GPI in a traditionally structured program. You'll see that it's not supported for a reason. (And, actually, I know of three ways to use GPI from a traditionally structured program, but they're all rather sleazy, so I won't discuss them here. Get on PC MagNet and ask me about them if you're interested in the gory details.)

■ The Graphics Programming Interface part of the PM is one of the hottest graphics programming systems ever created.

Before getting to the non-GPI Presentation Manager functions, however, let's first get our bearings by examining the distinction between Presentation Manager programs and other OS/2 programs.

THE THREE TYPES OF PROGRAMS As you probably know, OS/2 supports multiple full-screen sessions (sometimes called screen groups). Under OS/2 1.0, you can use each session to run a different program. You move from program to program by switching among the sessions.

Under OS/2 1.1, one of these sessions is devoted to the Presentation Manager. Within the Presentation Manager session, programs run in windows and share the video display. Although this is a more convenient approach to multitasking and task switching than using multiple full-screen sessions, the other full-screen sessions are still supported under OS/2 1.1.

OS/2 1.1 distinguishes between three types of OS/2 programs:

■ *Presentation Manager programs.* These are programs that use the Presentation Manager API to create windows. They obtain user input through PM messages and write output to their windows using GPI. Presentation Manager programs always run in the Presentation Manager session. The factor that really distin-

guishes a Presentation Manager program from the other two kinds is the presence of a call to the WinCreateMsgQueue (create message queue) function. I'll discuss the importance of this function in more detail shortly.

■ *Windowable character-mode programs.* These are programs that use the OS/2 kernel functions with the prefixes Kbd, Mou, and Vio to read input from the keyboard and mouse and to write output to the screen. Collectively, they're often known as VIO (video I/O) programs. VIO programs can be run either in a separate full-screen character-mode session or in a "text window" in the Presentation Manager session. The text window is a special type of window that the Presentation Manager creates to display the program's output. Any OS/2 program that uses only the normal C runtime library for input and output (`printf` and so forth) is a VIO program.

■ *Nonwindowable programs.* These are programs that use OS/2 kernel functions for the most part, but which, for one reason or another, cannot run in a window in the Presentation Manager session. Each such program must run in its own full-screen session, so they're often referred to as full-screen programs. A program written for OS/2 1.0 that uses graphics cannot run in a window in the Presentation Manager because the program writes directly to the screen. That would obviously be a disaster in the Presentation Manager session!

If you attempt to run a nonwindowable program in a Presentation Manager text window, OS/2 1.1 will cause certain function calls to fail. For example, the VioGetPhysBuf function (which is required for obtaining the address of video display memory for non-PM graphics) will succeed only if the program is running in its own session. Other function calls that affect the whole screen—such as VioSetMode, to set the video mode, or VioSetState, to set the color palette—will also return error codes if the calling program is running in a Presentation Manager window. Programs that run in a PM window are also prohibited from installing keyboard monitors and video, keyboard, or mouse subsystems.

Most programs written for OS/2 1.0 are VIO programs and so can run either in a full-screen session or in a text window in the Presentation Manager session. You can specify which you prefer when you install such a program in the Presentation Manager Start Programs menu.

SPECIFYING PROGRAM TYPES

OS/2 must always determine the type of program it is loading. If the program is a full-screen program and is being run from the Presentation Manager session, then OS/2 must create a new session for running the program. If a PM program is run from a non-PM session, then OS/2 must switch to the PM session to run the program. If a windowable program is being run in the PM session, the Presentation Manager must create a text window for it.

The most efficient way for OS/2 to determine the program type is by checking the program's .EXE file. Two bits of data—part of a 16-bit "flag word"—are devoted to this purpose. (The flag word is located 12 bytes from the beginning of the new header section in the .EXE file.)

The program type is originally specified by the programmer in a module definition (.DEF) file that LINK uses when linking the program. Based on information in the module definition file, LINK sets the appropriate code in the .EXE file. Generally quite short, the module definition file is an ASCII file that usually begins with a NAME statement. This statement indicates that the module is a program rather than a dynamic link library. (The module definition file for a dynamic link library contains a LIBRARY statement instead.) The full syntax of the NAME statement is

```
NAME [mod-name] [prog-type]
```

The first optional field, the module name, is almost always the name of the program's .EXE file. The optional program-type field can be one of the following three keywords:

```
WINDOWAPI
WINDOWCOMPAT
NOTWINDOWCOMPAT
```

These three keywords correspond directly to the three types of programs discussed above. The WINDOWAPI keyword indicates a PM program, the WINDOWCOMPAT keyword indicates a windowable VIO program, and the NOTWINDOWCOMPAT keyword indicates a full-screen nonwindowable program.

The program type is indicated by bits 8 and 9 of the flag word. NOTWINDOWCOMPAT programs have bit 8 set, WINDOWCOMPAT programs have bit 9 set, and WINDOWAPI programs have both bits set. This is one method (though, as we'll see, not the only one) that OS/2 uses to determine which type of program it's loading to run.

I DIDN'T KNOW THAT! Even if you've been programming for OS/2 1.0 for some time, you may not be familiar with the information in the previous section. Most people who write programs for OS/2 1.0 don't even bother to create a module definition file because it's not strictly required.

Apparently, the option of specifying a program type in the module definition file was conceived quite late in the development of OS/2 1.0—perhaps even after OS/2 1.0 was released. IBM's *OS/2 1.0 Technical Reference* does not mention it at all. Microsoft's *OS/2 1.0 Programmer's Reference* has an appendix on the OS/2 .EXE format that does not document the three program-type values shown above.

The only place Microsoft documented the program-type option was in the OS/2 updates to its compilers and macro assemblers, such as C 5.1 and MASM 5.1. It's in a section in the "CodeView and Utilities" update entitled "Using Module-Definition Files." And even here Microsoft got it wrong! The WINDOWAPI keyword is described in this documentation as specifying a "real-mode *Windows* application." No, no, no! The WINDOWAPI keyword has nothing to do with DOS or real mode or *Microsoft Windows*. It's used to indicate an OS/2 Presentation Manager program.

If a program is linked without a module definition file (or with a module definition file that does not include one of the three keywords shown above), bits 8 and 9 of the flag word in the program's .EXE file will be zero, indicating that the program type is unknown.

In this case, OS/2 must determine the program type in another way. One way is to let the user specify the program type when installing the program on the Start Programs window. This is not a general



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solution, however, since programs can also be run from a command-line prompt or from the file system. In the general case, OS/2 must make an assumption about the program type. Based on some experimentation, I think OS/2 does it this way: if the program contains a call to WinCreateMsgQueue, it's a Presentation Manager program. (OS/2 can determine the presence of a call to this function by searching through the imported function list in the .EXE file.) If the program does not contain a call to WinCreateMsgQueue, OS/2 assumes that the .EXE file is a nonwindowable full-screen program.

KERNEL API ENHANCEMENTS As I write this column (early January), I have not yet seen any documentation on new OS/2 kernel functions that have been added to OS/2 1.1. But a little exploration reveals that the program type shows up in one new kernel function and in an enhancement to an old function.

The DosQAppType (query application type) function has two parameters. The first is the name of a program file (such as PROGRAM.EXE) and the second is a pointer to a USHORT. OS/2 sets this USHORT to a code that indicates the program type of the .EXE file.

The DosGetInfoSeg (get information segments) function existed in OS/2 1.0, but some new information has been added to the structure that describes the local information segment. One of the new structure-field names is typeProcess, and it contains a code indicating the program type, as well.

The OS/2 1.1 BSEDOS.H header file contains some new identifiers (with the prefix PT, meaning program type) that allow programs to interpret the codes used by DosQAppType and the local information segment. These identifiers are PT_PM, PT_WINDOWABLEVIO, PT_FULLSCREEN, PT_DETACHED, and PT_REALMODE. The first three of these correspond to the WINDOWAPI, WINDOWCOMPAT, and NOTWINDOWCOMPAT keywords used in the module definition file. Obviously, an .EXE file cannot have a type of PT_DETACHED (a program can hardly be detached until it is run), but a running process could have this type. I don't know what the PT_REALMODE type is used for, if it's even used for anything.

GETTING THE MESSAGE As we've seen, the WinCreateMsgQueue function is what distinguishes a Presentation Manager program from a non-PM program. If you think about it, this makes a lot of sense. What's the major difference between a PM program and a non-PM program? It's the message-based architecture. Presentation Manager programs create windows that get user input (and other important information) in the form of messages. These messages are stored in the program's message queue. The WinCreateMsgQueue function creates a message queue for windows that are created by the program.

The importance of WinCreateMsgQueue was quite obvious in some of the early prerelease versions of the Presentation Manager. These versions did not include the Presentation Manager shell programs, and the system booted into a character-mode session. You could run a PM program from the OS/2 command line. It was during the program's call to WinCreateMsgQueue that the screen switched from character mode to graphics.

■ The major difference between a PM program and a non-PM program is the message-based architecture.

A Presentation Manager program must create a message queue before it can create windows. User input, in the form of keyboard and mouse messages, comes through the message queue. Program output (originating from calls to GPI functions) is displayed on the surface of the window.

INPUT AND OUTPUT It's important to realize that you can't write a program that is partly a Presentation Manager program and partly a non-PM program. A program that does not call WinCreateMsgQueue is not a PM program. The program cannot create windows because there is no queue to store messages directed to the windows. Nor (without resorting to some questionable tactics) can the program use GPI, because GPI output must go to a window.

Likewise, the very presence of the WinCreateMsgQueue function in a program makes it a Presentation Manager program. Even if the program never calls the function, it's still a PM program. It wouldn't be a very useful program in such a case, however, because it can't create windows and hence can't read user input or display output to the screen.

A non-PM program uses functions with the Kbd and Mou prefixes to obtain user input from the keyboard and mouse. These functions return error codes if they are called from a Presentation Manager program. PM programs get keyboard and mouse input through messages.

A non-PM program calls functions with the Vio prefix to display text to the screen. Again, the Vio functions generally return an error code if called from a Presentation Manager program. A PM program uses GPI to display text and graphics to a window. (There is an exception to this rule—the Presentation Manager supports a system called Advanced VIO which lets the program write to its window using Vio functions as if the window were a character-mode output device.)

Otherwise, virtually all of the other OS/2 kernel functions (in particular, those beginning with the Dos prefix) are allowed in both Presentation Manager and non-PM programs.

WHAT ABOUT PRINTF? What about standard input and standard output in a Presentation Manager program? Can a PM program call the DosWrite function with a handle of 1 (standard output)? For that matter, can a PM program call `printf`?

Standard input and standard output are still somewhat valid concepts in the Presentation Manager. But keep in mind that, unless standard input has been redirected, OS/2 will eventually attempt to use a Kbd function to obtain input from the keyboard. This function will fail. Likewise, if standard output has not been redirected, OS/2 will use a Vio function to write the



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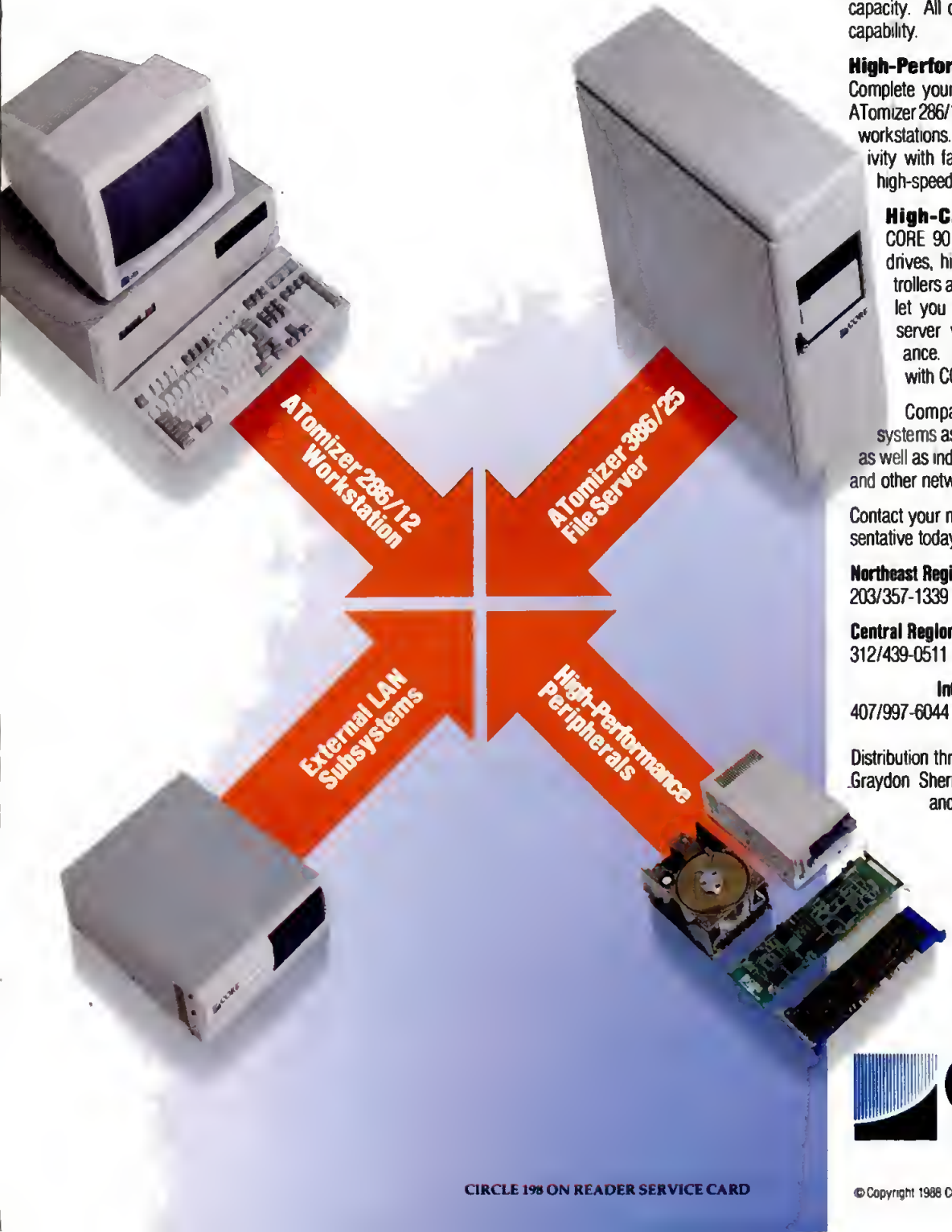
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■ ENVIRONMENTS

output to the screen, and that function will also fail. But if a PM program calls `printf` when standard output is redirected to a file, it will work just fine.

You may ask, Why can't IBM and Microsoft fix the `printf` function so that it does something reasonable in a Presentation Manager program, like write some text to the program's window? But a PM program can create many windows. On *which* of the program's windows should `printf` display text?

This illustrates how old concepts to which we've been accustomed lose their relevance in the very different environment of the Presentation Manager. In a PM program, you don't display something "on the screen," as `printf` does. Instead, you display something "on a window," and you must be able to identify which window.

GPI IN A NON-PM PROGRAM Earlier in this column I noted that some programmers would probably like to use GPI in a traditionally structured non-PM program, so let's consider that approach.

At first, it seems reasonable. After all, there seems to be no reason why graphics should be tied to a windowing or message-driven environment. Many graphics programming systems are designed for traditionally structured programs running in a full-screen environment. Why can't OS/2 1.1 give programmers the option to use GPI like this?

In truth, it probably would have been easy enough for IBM and Microsoft to add this facility to OS/2. Indeed, I wouldn't be surprised if they instead had to do something special to prevent non-PM programs from easily using GPI.

What's the problem? In a word, memory. OS/2 is a multitasking operating system. It must be able to run multiple programs and allow the user to switch among these programs. Full-screen programs using graphics should be no different.

The IBM 8514/A board has a 1,024-by-768 resolution with 256 simultaneous colors. Boards like the 8514/A will eventually be fairly standard in Presentation Manager systems. The 8514/A requires a minimum of 768K just for the visible part of the video buffer, and it actually provides a total of 1MB of memory.



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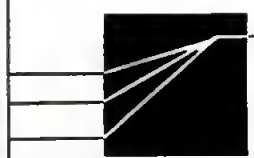
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Imagine 16 programs running in 16 sessions, each of which is using an 8514/A (or comparable) board in a graphics mode. To allow the user to switch among these programs, OS/2 must save and restore each program's video buffer. This means that OS/2 would have to devote 16MB of memory just to video images.

That's ridiculous! We really can't tolerate an environment in which each graphics program has a memory overhead of 1MB. But that's exactly what would happen if programs were allowed to use GPI outside the Presentation Manager session.

THE PM SOLUTION You might think that even when programs use GPI only within the one Presentation Manager session, OS/2 would still have to save at least one big video buffer (the one associated with the Presentation Manager itself) when the user switches among sessions. But this is not so. Let's see why.

We'll ignore the DOS compatibility session for the moment and assume that we've booted up with DOS mode disabled. When you switch among the PM session and the other OS/2 sessions, the only part of the video buffer that is saved is the first 16K. This allows non-PM sessions to use such things as the VGA 60-line mode and even CGA-compatible graphics. When the user switches back to the PM session, all that needs to be restored is the first 16K. The rest of the video buffer has not been altered by the other sessions.

But what if a non-PM program in another session decides to use graphics? To do this under the current system, the program would have to obtain selectors to the physical video buffer and write directly into video memory. That's similar to the way programs use graphics under DOS. In this case, OS/2 still does not save the video buffer associated with the Presentation Manager session, even though a non-PM program is destroying its contents.

What happens, then, when you switch back to the Presentation Manager session? Simple—all the windows in the PM session receive WM_PAINT. These messages just direct the windows to repaint themselves and the screen is restored.

So we see that a message-based architecture is really quite important in a multitasking multiple-session environment.



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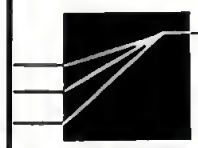
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OS/2 does not need to devote huge chunks of memory to save giant video buffers. Presentation Manager programs can easily re-create the appearance of their windows just by reexecuting their painting code in response to a normal WM_PAINT message.

Non-PM programs that use graphics are actually put under a greater burden for session switching than PM programs. Non-PM programs that use graphics must create a couple of additional threads in order to be informed when a session switch is about to occur. They must save the contents of the video buffer and restore it later, when the user switches back to the session. Presentation Manager programs don't have to save video buffers—all they have to do is re-create the appearance of their windows on receipt of a WM_PAINT message, and this is done through normal program code.

(Of course, the DOS-compatibility-mode session complicates all this. There is no way for OS/2 to know what DOS programs do with the video display. The entire video buffer associated with the DOS session must be preserved across session switches by the operating system. This is the only case in which OS/2 must save a full video buffer. Getting rid of the DOS-compatibility session frees up that memory for more useful purposes.)

ARCHITECTURE FOR A PURPOSE

Clearly, the support of high-resolution graphics in a multitasking environment requires some special considerations. An operating system that attempted to save entire video buffers would be very wasteful of memory. For this reason, then, responsibility for refreshing display output must be left to each individual program. Only the program knows how to do this in the most efficient way. Thus, programs must be made aware when they need to refresh their display output. This requires some kind of messaging system similar to the one implemented in the Presentation Manager.

Is it just coincidence that every multitasking graphical user interface is built around a message-based architecture? Not at all. This type of architecture happens to be the most efficient and elegant solution to the various problems involved with programs sharing system resources such as the video display.

I can sympathize with those who find the message-based architecture of the Presentation Manager difficult and who would prefer to use GPI in non-PM programs. But everything in the Presentation Manager fits together in the unifying architecture. You really can't pull pieces out and use them in a coherent and efficient manner.

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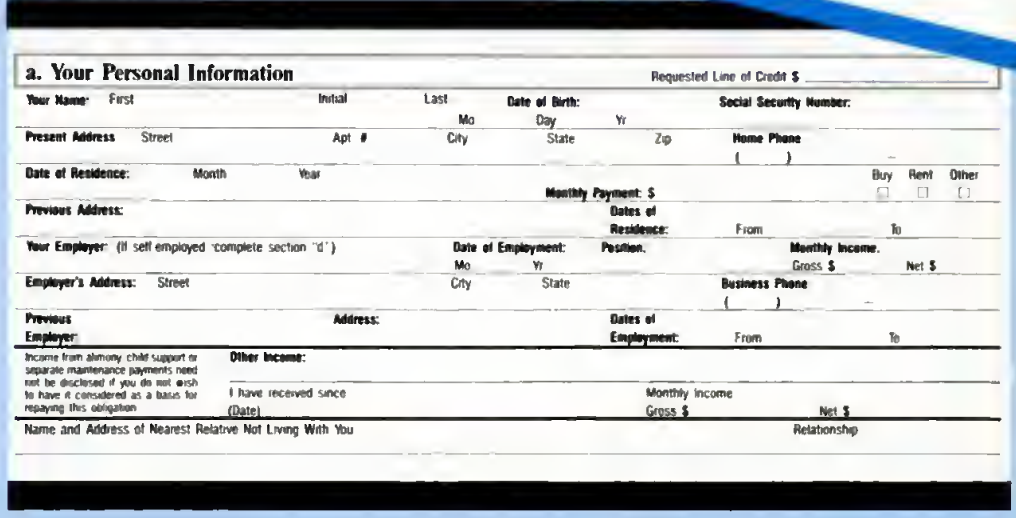
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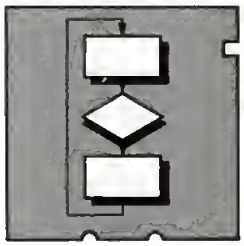
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■ POWER PROGRAMMING ■ RAY DUNCAN

PUTTING A MOUSE IN YOUR PROGRAMS



Even dedicated keyboard pounders must recognize the need to provide mouse support in today's applications. Here's how you can do this in DOS and OS/2.

The DOS command line interface has an ancient and honorable pedigree. MS-DOS inherited many of its commands from its progenitor, 86-DOS, which was written by Tim Paterson of Seattle Computer in 1980. 86-DOS was itself patterned after the Digital Research CP/M operating system for 8080 and Z-80-based microcomputers, which was written by Gary Kildall in 1976. And many of CP/M's commands, in turn, were modeled on those in DEC's RSTS and RT-11 operating systems, to which Kildall was exposed during his work at the Naval Postgraduate Center in Monterey, California.

Until the last couple of years, most DOS applications have followed the example of MS-DOS's own COMMAND .COM. That's to say, they have relied on command lines or key-driven menus and text-mode displays. *Lotus 1-2-3*, *WordStar*, and *dBASE* exemplify this type of user interface. Such programs certainly can be efficient and productive—the millions of copies of *1-2-3* in daily use testify to that—but they tend to have steep learning curves.

In contrast, Macintosh programs use a windowing, graphical user interface that is both uniform across all applications and very easy to learn. These programs typically employ pull-down menus, dialog boxes, and a pointing device—a mouse, stylus, joystick, trackball, or light pen—with which the user navigates in a "point-and-shoot" manner. Keyboard entry is reduced to a minimum. The routines that control the appearance of the screen and manage user input are located in ROM and are shared by all application programs.

Largely because of their graphical user interface and the use of pointing devices, Macintosh applications have enviably short learning curves and require little (by DOS standards) in the way of documentation. Most of a user's experience with other Macintosh programs is immediately applicable to any new program, and anything else he needs to know he can usually learn interactively rather than by looking in a manual.

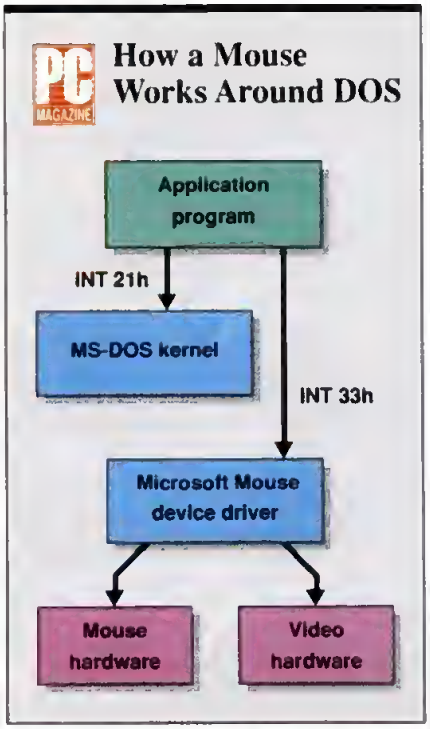


Figure 1: *Mouse-aware applications running under DOS maintain two distinct I/O tracks: character I/O through interrupt 21h and mouse control through interrupt 33h.*

As high-resolution graphics adapters (and 80286/386-based machines with enough power to drive them) have become less expensive, there has been increasing pressure on PC developers to follow the lead of the Macintosh and provide users with a richer, more intuitive interface. Programs that are "mouse-aware" and use pull-down menus are becoming quite common, and more and more developers are moving to *Microsoft Windows* and the OS/2 Presentation Manager, both of which provide a hardware-independent graphical environment with Mac-like functionality.

It behooves us, then, when we write a new program or upgrade an old one, to think about including support for a mouse (or other pointing device) wherever it is appropriate. Although full-scale programming for *Windows* and/or the Presentation Manager is well beyond the scope of this column, simply adding mouse support to a conventional DOS or OS/2 program is not difficult. Let's take a quick look at the basic issues and techniques involved.

SYSTEM MOUSE SUPPORT Unfortunately, pointing device support is not an integral part of DOS, so there is no "official" standard set of pointing device functions at the system level. The functionality of the Microsoft Mouse driver has made it a de facto standard, however, and an equivalent set of functions is supported by most other manufacturers of mice and other pointing devices.

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The DOS Microsoft Mouse driver is loaded by a DEVICE= statement in the CONFIG.SYS file, and it masquerades as a character device driver. Once the driver is loaded, however, application programs interact with it directly, using software interrupt 33h and bypassing MS-DOS completely, as shown in Figure 1. You cannot open the mouse driver by name and manipulate it using normal DOS interrupt 21h function calls.

The mouse support in OS/2 is actually spread among four different modules. The driver that tracks the mouse position and button state has the logical name MOUSE$ and is loaded by a DEVICE= statement in CONFIG.SYS, just as under DOS. OS/2 is shipped with several different MOUSE$ drivers, covering the Microsoft Serial Mouse, Microsoft Bus Mouse, Microsoft Inport Mouse, and Mouse Systems Optical Mouse. The code that maintains the mouse pointer on the screen resides in a separate device driver with the logical name POINTER$.

OS/2 applications invoke mouse functions by far calls to named entry points, passing parameters on the stack. The functions have names of the form Mouxxx, and the entry points reside in the "router" module, MOUCALLS.DLL. MOUCALLS sends the function call on to the appropriate "mouse subsystem" for the current screen group; the default subsystem is called BMSCALLS.DLL. BMSCALLS, in turn, communicates with the MOUSE$ and POINTER$ drivers via DosDevIOCtl calls, as shown in Figure 2.

Mouse support is somewhat restricted in OS/2 programs that are not running in the Presentation Manager screen group. The MOUSE$ driver works properly in all "standard" text and graphics modes, but the POINTER$ driver works properly only in text modes. Thus, if a non-Presentation Manager application selects a graphics mode and wishes to use the mouse, it must disable the system's pointer driver and provide the mouse cursor itself.

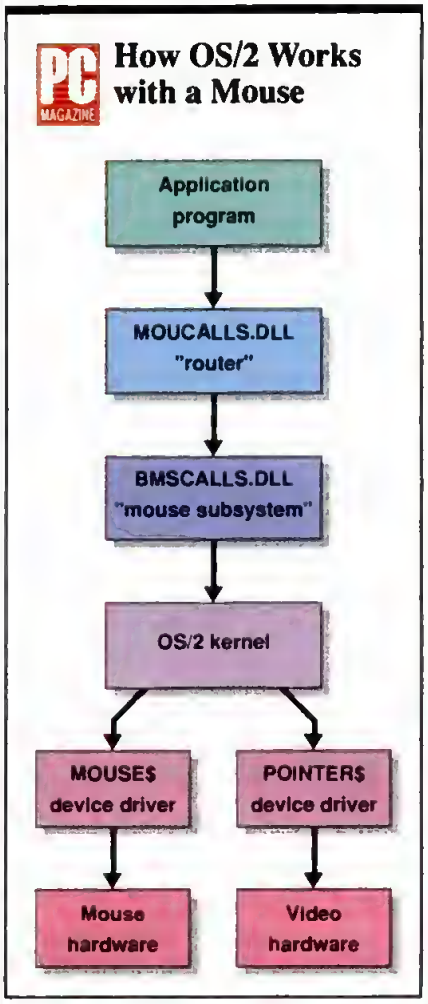


Figure 2: *Applications running under OS/2 communicate with the mouse via a series of dynamic link libraries. First MOUSCALLS.DLL routes function calls to the current screen group's link library (BMSCALLS.DLL is the default). Then DosDevIOCtl calls communicate with the hardware device drivers.*

MOUSE FUNCTION CALLS Version 6 of the Microsoft Mouse driver supports some 35 different function calls, and the OS/2 mouse subsystem has about 25. Although this number of mouse functions may seem intimidating, the average application needs only a few of them.

A DOS program first calls interrupt 33h function 00h (Reset Mouse Driver) to initialize the mouse driver for the current display mode and to check its status. At this point, the mouse is "alive" and the application can obtain its state and position; the pointer does not become visible, however, until the process calls interrupt 33h function 01h (Show Mouse Pointer).

The program can then call interrupt 33h functions 03h (Get Mouse Position and

```
/*
    MOUDEMO1.C -- Simple MS-DOS Demo of Mouse Driver
    Copyright (C) 1986 Ziff Communications Co.
    PC Magazine * Ray Duncan * May 16, 1989 */

    Compile:    CL MOUDEMO1.C

    Usage:      MOUDEMO1  (press both mouse buttons to exit)
*/

#include <stdio.h>
#include <dos.h>

union REGS regs;

void cls(void);                         /* function prototypes */
void gotoxy(int, int);
int  mopen(int *);
void mclose(int);
void mrsxd(int, int *, int *, int *);
void mhide(int);
void munhide(int);

main(int xrgc, char *argv[])
{
    int x,y,buttons;                    /* mouse state variables */
    int mhandle;                        /* mouse handle from mopen */

    if(! mopen(&mhxndle))               /* exit if no mouse */
    {
        printf("\nMouse not available\n");
        exit(1);
    }

    cls();                              /* clear the screen */
    gotoxy(45,0);                       /* and show help info */
    puts("Press Both Mouse Buttons To Exit");

    munhide(mhxndle);                   /* make mouse cursor visible */

    do {                                /* read mouse position & buttons */
        mrsxd(mhandle, &x, &y, &buttons);
        gotoxy(0,0);                    /* display mouse status */
        printf("X = %3d  Y = %3d", x, y);
    }   while(buttons != 3);            /* exit if both buttons down */

    mhide(mhandle);                     /* hide mouse cursor */
    mclose(mhandle);                    /* release mouse driver */
    cls();                              /* clear screen and exit */
}

/*
    Clear the screen and position cursor at (x,y) = (0,0)
*/
void cls(void)
{
    printf("\x01b[2J");
}

/*
    Position cursor to (x,y); ANSI driver uses 1-based coordinates.
*/
void gotoxy(int x, int y)
{
    printf("\x01b[%d;%dH",y+1,x+1);
}

/*
    Initialize mouse driver, return mouse status and handle.
    Status is true if mouse available, false if not.  Handle is
    dummy value in MS-DOS version.
*/
int mopen(int *handle)
{
    regs.x.ax = 0;                      /* function 0 = reset driver */
    int86(0x33, &regs, &regs);
    *hxndle = 0;                        /* set dummy mouse hxndle */
    return(regs.x.ax);                  /* and return status */
}

/*
    Make mouse pointer visible. Mouse handle is dummy in MS-DOS version.
*/
void munhide(handle)
{
    regs.x.ax = 1;                      /* function 1 = display pointer */
    int86(0x33, &regs, &regs);
}

/*
    Hide mouse pointer.  Mouse handle is dummy in MS-DOS version.
*/
void mhide(handle)
{
    regs.x.ax = 2;                      /* function 2 = hide pointer */
    int86(0x33, &regs, &regs);
}

/*
    Read mouse position and button status.  Mouse handle is dummy
    in MS-DOS version.
*/
void mread(int handle, int *x, int *y, int *buttons)
{
    regs.x.ax = 3;                      /* function 3 = get position */
    int86(0x33, &regs, &regs);          /* and button status */
    *buttons = regs.x.bx & 3;
    *x = regs.x.cx;
    *y = regs.x.dx;
}

/*
    Release mouse driver.  Mouse handle is dummy in MS-DOS version.
*/
void mclose(handle)
{
    regs.x.ax = 0;                      /* function 0 = reset driver */
    int86(0x33, &regs, &regs);
}
```

Figure 3: *MOUDEMO1.C, a simple mouse demonstration program for DOS.*

```
/*
    MOUDEMO2.C -- Simple OS/2 Demo of Mouse Subsystem
    Copyright (C) 1989 Ziff Communications Co.
    PC Magazine * May Duncan * May 16, 1989 */

    Compile:    CL MOUDEMO2.C

    Usage:      MOUDEMO2  (press both mouse buttons to exit)
*/

#include <stdio.h>

void cls(void);                         /* local function prototypes */
void gotoxy(int, int);
int  mopen(int *);
void mclose(int);
void mread(int, int *, int *, int *);
void mhide(int);
void munhide(int);

#define API unsigned extern far pascal

API MouClose(int);                      /* OS/2 function prototypes */
API MouGetPtrPtr(int);
API MouOpen(void far *, int far *);
API MouReadEventQue(void far *, int far *, int);
API MouRemovePtr(void far *, int);

struct _MouEvent {  unsigned Flags;
                    long Timestamp;
                    int Row;
                    int Col;
                 } ;

main()
{
    int x,y,buttons;                    /* mouse state variables */
    int mhandle;                        /* mouse handle from mopen */

    if(! mopen(&mhxndle))               /* exit if no mouse */
    {
        printf("\nMouse not available\n");
        exit(1);
    }

    cls();                              /* clear the screen */
    gotoxy(45,0);                       /* and show help info */
    puts("Press Both Mouse Buttons To Exit");

    munhide(mhandle);                   /* make mouse cursor visible */

    do {                                /* read mouse position & buttons */
        mread(mhandle, &x, &y, &buttons);
        gotoxy(0,0);                    /* display mouse status */
        printf("X = %3d  Y = %3d", x, y);
    }   while(buttons != 3);            /* exit if both buttons down */

    mhide(mhandle);                     /* hide mouse cursor */
    mclose(mhandle);                    /* release mouse driver */
    cls();                              /* clear screen and exit */
}

/*
    Clear the screen and position cursor at (x,y) = (0,0)
*/
void cls(void)
{
    printf("\x01b[2J");
}

/*
    Position cursor to (x,y); ANSI driver uses 1-based coordinates.
*/
void gotoxy(int x, int y)
{
    printf("\x01b[%d;%dH",y+1,x+1);
}

/*
    Initialize mouse driver, return mouse status and handle.
```

(continues)

Figure 4: *MOUDEMO2.C, a simple mouse demonstration program for OS/2.*

■ POWER PROGRAMMING

```
    Mtatus is true if mouse available, false if not.
*/
int mopen(int *handle)
{
    return(! MouOpen(0L, handle));  /* open mouse, save handle, */
}                                   /* and return status */

/*
    Make mouse pointer visible.
*/
void mshide(handle)
{
    MouDrawPtr(handle);
}

/*
    Hide mouse pointer.  For the purposes of this demo, we
    assume an 80-by-25 text mode.
*/
void mhide(handle)
{
    static int HideArea[4] = { 0, 0, 24, 79 } ;

    MouRemovePtr(HideArea, handle);
}

/*
    Read mouse position and button status.
*/
void mread(int handle, int *x, int *y, int *buttons)
{
    int MaitOption = 1 ;            /* wait for a mouse event */
    struct _MouEvent MouEvent;      /* receives mouse information */

    MouReadEventQue(&MouEvent, &MaitOption, handle);

    *x = MouEvent.Col;              /* return mouse coordinates */
    *y = MouEvent.Row;              /* and button status */
    *buttons = ((MouEvent.Flags&4)>>2) | ((MouEvent.Flags&0x18)>>3) & 3;
}

/*
    Release mouse driver.
*/
void mclose(handle)
{
    MouClose(handle);
}
```

(Figure 4 ends)

Button Status), 05h (Get Button Press Information), and 06h (Get Button Release Information) to monitor the mouse position and the status of the mouse buttons. The program can also control the mouse position with interrupt 33h function 04h (Set Mouse Pointer Position), and change the mouse pointer shape with interrupt 33h functions 09h and 0Ah (for graphics and text modes, respectively).

But the program can register an event handler for mouse events using interrupt 33h function 0Ch, eliminating the need to poll the mouse driver. Instead, the driver notifies the program by calling the event handler whenever the mouse is moved or a button is pressed or released.

When the application is through with

```
        title   MOUSE.ASM Mouse Event Handler for C Programs
        page    55,132
;-----------------------------------------------------------------------
; MOUSE.ASM -- Mouse Event Handler for C Programs
; Copyright (C) 1989 Ziff Communications Co.
; PC Magazine * Ray Duncan * May 16, 1989
;
; Assemble with:  MASM /Mx MOUSE;
;-----------------------------------------------------------------------
args    equ     4               ; stack offset of arguments,
                                ; C small model

DGROUP  group   _DATA

_DATA   segment word public 'DATA'

mflag   dw      ?               ; offset of mouse event flag
xcoord  dw      ?               ; offset of X variable
ycoord  dw      ?               ; offset of Y variable
buttons dw      ?               ; offset of buttons variable

_DATA   ends


_TEXT   segment word public 'CODE'

        assume  cs:_TEXT,ds:DGROUP

;-----------------------------------------------------------------------
; The procedure 'aregister' is called by the C program with
; the addresses of four variables: an event flag, which is
; set to TRUE by the event handler whenever the mouse changes
; state, and three variables to receive the mouse's X and Y
; coordinates and the state of the mouse buttons.
;
; The C prototype for the function is:
;
;   void aregister(int *flag, int *x, int *y, int *buttons)
;-----------------------------------------------------------------------

        public  _mregister
_mregister proc near
                                ; parameters passed by C program
foffs   equ     [bp+args]       ; offset of event flag variable
xoffs   equ     foffs+2         ; offset of X variable
yoffs   equ     xoffs+2         ; offset of Y variable
boffs   equ     yoffs+2         ; offset of buttons variable

        push    bp              ; set up stack frame
        mov     bp,sp
        push    si              ; protect register variables
        push    di

        mov     ax,boffs        ; save offsets of the
        mov     buttons,ax      ; C program's variables
        mov     ax,yoffs
        mov     ycoord,ax
        mov     ax,xoffs
        mov     xcoord,ax
        mov     ax,foffs
        mov     mflag,ax

                                ; register Mouse event handler
        push    cs
        pop     es              ; ES:DX = handler address
        mov     dx,offset _TEXT:mhandler
        mov     cx,1fh          ; CX = event mask
        mov     ax,0ch          ; function 0CH = register
        int     33h             ; transfer to mouse driver

        pop     di              ; restore register variables
        pop     si              ; and discard stack frame
        pop     bp
        ret                     ; back to caller

_mregister endp


;-----------------------------------------------------------------------
; The mouse event handler is entered by a far call from the
; mouse driver whenever a mouse event occurs corresponding
; to the event mask passed in the original registration call.
; At entry to the handler, the registers are set up as follows:
;
;       AX      = mouse event flags:
;                       bit     significance
;                       0       mouse movement
;                       1       left button pressed
;                       2       left button released
;                       3       right button pressed
;                       4       right button released
;                       5-15    reserved
;       BX      = button state
;                       bit     significance
;                       0       left button is down
;                       1       right button is down
;                       2-15    reserved
;       CX      = X coordinate
;       DX      = Y coordinate
;       SI      = raw vertical mickey count
;       DI      = raw horizontal mickey count
;       DS      = mouse driver data segment
;-----------------------------------------------------------------------

mhandler proc   far

        push    ds              ; save mouse driver's data segment
        mov     di,DGROUP       ; make our data segment addressable
        mov     ds,di
        mov     di,xcoord       ; get offset of X coordinate variable
        mov     [di],cx         ; store X coordinate
        mov     di,ycoord       ; get offset of Y coordinate variable
        mov     [di],dx         ; store Y coordinate
        mov     di,buttons      ; get offset of buttons variable
        mov     [di],bx         ; store button state
        mov     di,mflag        ; get offset of event flag variable
        mov     word ptr [di],1 ; set the variable to TRUE
        pop     ds              ; restore mouse driver's data segment
        ret                     ; and return to driver

mhandler endp


_TEXT   ends

        end
```

Figure 5: *MOUSE.ASM, a MASM mouse event handler that can be linked to DOS C programs.*

```
/*
    MOUDEMO3.C --- Demonstretes use of MOUSX.ASM Event Nandler
    Copyright (C) 1989 Siff Davis Communications Co.
    PC Nagexine * Nay Duncan * Nay 16, 1989 */

    Compile:    NASN /Nx MOUSX;
                CL MOUDEMO3.C MOUSE

    Usage:      MOUDEMO3  (press both mouse buttnns to exit)
*/

#include <stdin.h>
#inciude <dos.h>

uoion REGS rege;

vnid cis(void);                     /* locel function prototypes */
void gotnxy(iot, int);
int  mopen(int *);
void mclose(int);
void mhide(int);
void munhide(int);

                                    /* protntype fnr MOURE.ASM */
void extern mregister(int *, int *, int *, int *);

main()
{
    int x,y,buttons;                /* mouse stete veriehles */
    int mhandle;                    /* mouse hendle from mopen */
    int mfleg = 8;                  /* mouse event fleg */

    if(! mopen(&mhendle))           /* eeit if no mouse */
    {
        printf("\nMouse not eveiiebie\n");
        exit(1);
    }

                                    /* register mouse event handler */
    mregieter(&mfieg, &x, &y, &buttons);

    cis();                          /* clear the screen */
    gotnxy(45,8);                   /* and show heip infe */
    puts("Prese Both Mouee Buttons  , Exit");

    munhide(mhendie);               /* make mouse cureor visibie */

    whiie(1)                        /* loop practiceliy forever */
    {
        if(mfieq)                   /* if mouse event detected */
        {
            gotoxy(8,8);            /* displey mouse stetne */
            printf("X = %3d  Y = %3d", x, y);
            mfleg = 8;              /* reeet mouse event fleg */

            if(buttons == 3) break; /* exit if both buttons down */
        }
    }

    mhide(mhendie);                 /* hide mouse cursor */
    mcicee(mhandle);                /* releeee mouse driver */
    cle();                          /* clear ecreen and exit */
}

/*
    Clear the screen and positioo cersor et (x,y) = (8,8)
*/
void cls(void)
{
    printf("\x81b[2J");
}

/*
    Position cureor to (x,y); ANSI driver uses 1-beeed coordinetes.
*/
void gotoxy(int x, int y)
{
    printf("\x81b[%d;%dH",y+1,e+1);
}

/*
```

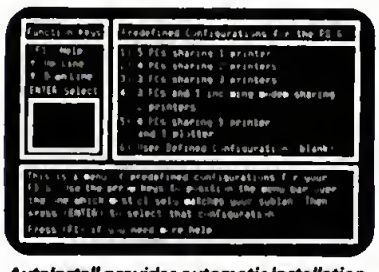
(continues)

Figure 6: *MOUDEMO3.C, a C program for DOS that illustrates the use of the event handler in MOUSE.ASM.*

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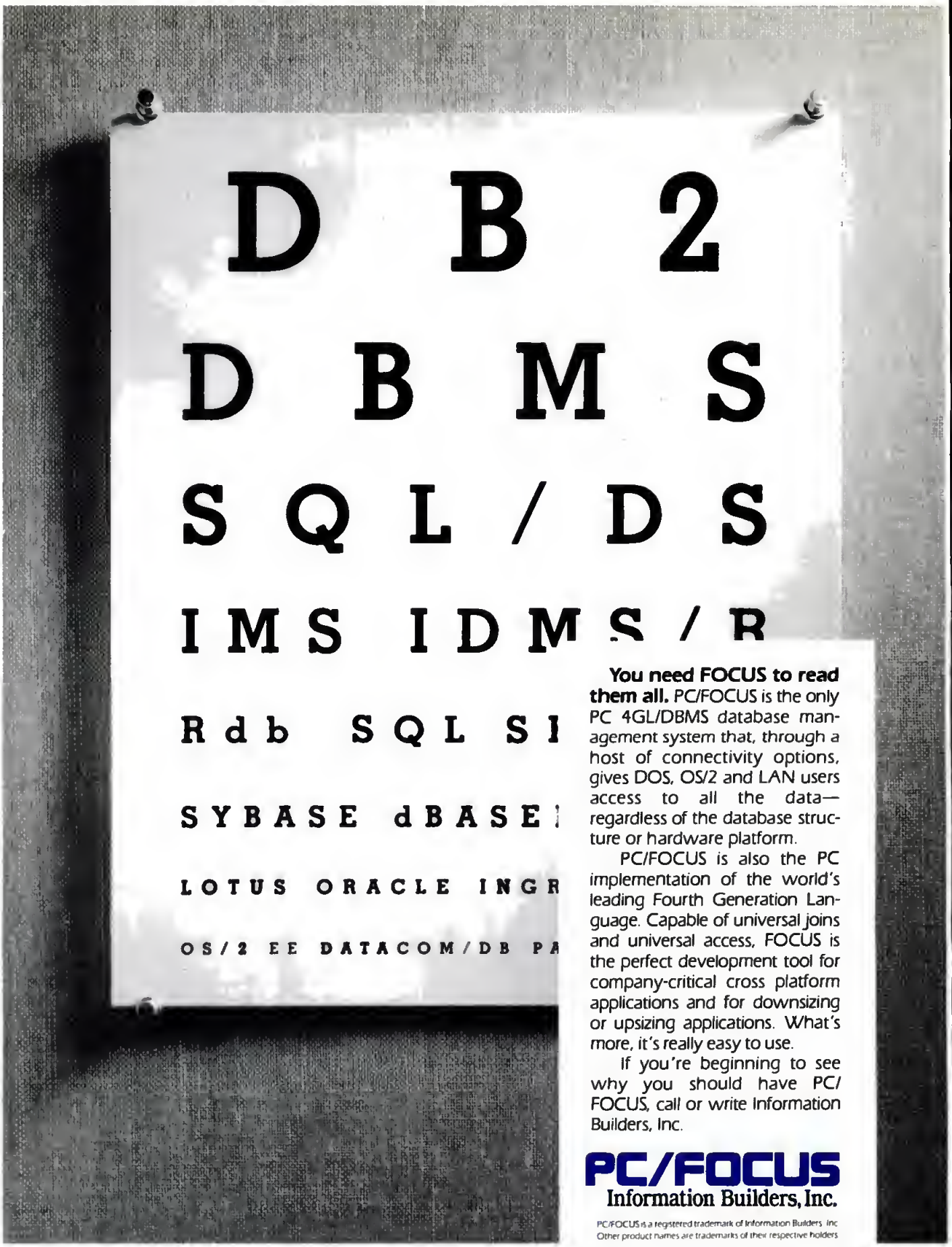
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■ POWER PROGRAMMING

```
    Initialise mouse driver, return mouse status and handle.
    Status is true if mouse available, false if not.  Handle is
    dummy value in MS-DOS version.
*/
int mopen(int *handle)
{
    regs.x.ax = 0;                  /* function 0 = reset driver */
    int86(0x33, &regs, &regs);
    *handle = 0;                    /* set dummy mouse handle */
    return(regs.x.ax);              /* and return status */
}

/*
    Make mouse pointer visible.  Mouse handle is dummy in MS-DOS version.
*/
void mshide(handle)
{
    regs.x.ax = 1;                  /* function 1 = display pointer */
    int86(0x33, &regs, &regs);
}

/*
    Hide mouse pointer.  Mouse handle is dummy in MS-DOS version.
*/
void mhide(handle)
{
    regs.x.ax = 2;                  /* function 2 = hide pointer */
    int86(0x33, &regs, &regs);
}

/*
    Release mouse driver.  Mouse handle is dummy in MS-DOS version.
    This incidentally disables mouse event handler calls from
    mouse driver.
*/
void mclose(handle)
{
    regs.x.ax = 0;                  /* function 0 = reset driver */
    int86(0x33, &regs, &regs);
}
```

(Figure 6 ends)

the mouse, it can call interrupt 33h function 02h to hide the mouse pointer. If the program has registered an interrupt handler for mouse events, it should disable further calls to the handler by resetting the mouse driver again with interrupt 33h function 00h.

An OS/2 program first calls MouOpen to initialize the mouse subsystem for its screen group (if it's not already initialized) and to obtain a logical mouse handle. The application can then query the mouse's state and position, but the pointer does not appear on the screen until the program calls MouDrawPtr.

The program uses MouReadEventQue to obtain mouse event packets from the mouse driver's FIFO queue. These packets contain flags that indicate the type of event (button press, button release, mouse movement, or a combination), a time stamp, and the mouse pointer position. MouReadEventQue has a no-wait option so that the application can avoid blocking if no mouse events are waiting. An application can also test the number of waiting events with MouGetNumQueEl.

As an alternative to MouReadEventQue, an application can simply poll the mouse position at convenient intervals



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■ POWER PROGRAMMING

with MouGetPtrPos. This function does not return the current state of the mouse buttons, however, and frequent polling can degrade the performance of the entire system because it burns up CPU cycles that could be put to more effective use by other programs running concurrently.

When the program is done with the mouse, it can call MouClose to release its mouse handle. Otherwise, the OS/2 kernel closes the mouse handle on behalf of the program as part of the normal cleanup at termination. When the last program using the mouse in the group terminates or calls MouClose, the mouse subsystem is disabled for the screen group, and the pointer is removed from the screen.

A complete description of the DOS Microsoft Mouse driver function calls can be found in the *Microsoft Mouse Programmer's Reference Guide* (Part No. 000-099-066), which is available directly from Microsoft for $25. An alternative source is my book, *Advanced MS-DOS Programming* (2nd Edition). The OS/2 mouse subsystem function calls are documented in the *Microsoft OS/2 Programmer's Reference*, the IBM *OS/2 Technical Reference*, and in most OS/2 trade books, including my own *Advanced OS/2 Programming*.

MOUSE DEMOS Figure 3 contains a simple DOS demonstration program, MOUDEMO1.C, that continually polls and displays the mouse position. The listing in Figure 4, MOUDEMO2.C, is essentially the same program, modified for use under OS/2. It also illustrates how you can bury the differences between the two systems in subroutines.

You can terminate either program, MOUDEMO1 or MOUDEMO2, by pressing both mouse buttons or entering Ctrl-C or Ctrl-Break. To minimize the tangential differences between the two programs, I've used ANSI escape sequences to clear the screen and position the cursor, even though these are much too slow and clumsy for use in a normal application.

The remaining two source listings show you how to set up and use an event handler with the DOS mouse driver. Figure 5, MOUSE.ASM, contains two assembly language subroutines that can be linked with any small-model C application. The first routine, mregister, is called by the C

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program with the addresses of four variables to install the event handler. One of the four variables is simply a flag that is initialized to "false" and is set to "true" by the event handler whenever the mouse changes state. The other three variables receive the mouse's *x*- and *y*-coordinates and button state.

The other assembly language procedure, mhandler, is the event handler proper. It is entered with a far call from the mouse driver whenever the mouse is moved or a button is pressed or released. The handler updates the variables with the current mouse position and state and then sets the event flag to true. The C program can interrogate the flag and inspect the other variables whenever it is convenient.

Figure 6, MOUDEMO3.C, is a simple C application that shows the use of the procedures in MOUSE.ASM. It initializes the mouse driver, displays the mouse pointer, and then idles in a loop while monitoring the event flag. When the flag becomes true, MOUDEMO3 displays the mouse coordinates and clears the flag. If both buttons are pressed, MOUDEMO3 exits; otherwise, it returns to waiting.

You can build MOUDEMO3.EXE from MOUDEMO3.C and MOUSE .ASM with the following commands:

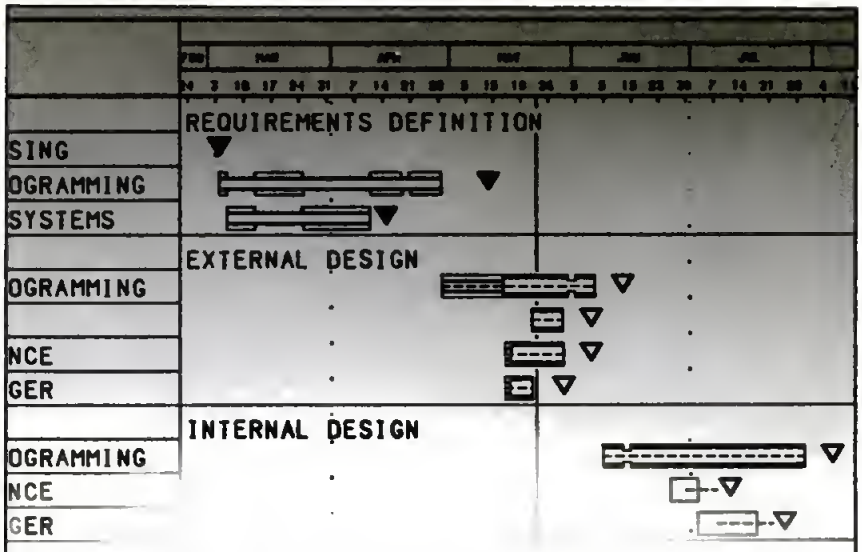
```
MASM /Mx MOUSE;
CL MOUDEMO3.C MOUSE
```

The /Mx switch tells the assembler to preserve case in extemal names. If you fail to provide this switch, the Linker will complain that it could not resolve the symbol _mregister.

The tight loop that monitors the event flag in MOUDEMO3 should not be taken as a model. In a real application you would want the program to do useful work between the mouse events. After all, the whole point of using an event handler is to eliminate the time wasted in polling the mouse when no mouse activity has occurred.

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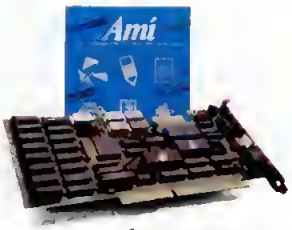
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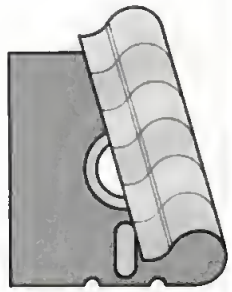
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SPREADSHEET CLINIC



Simple macros for making 1-2-3 beep after recalculation, calculating the final day of successive months, and saving different versions of worksheets.

A macro that saves new versions of a worksheet in different files

When I am working with *1-2-3*, I often save successive versions of a worksheet in files with different names. For example, I might save the first version of a budget worksheet under the filename BUDGET1.WK1, the second version of that worksheet under the name BUDGET2.WK1, the third version of that worksheet under the name BUDGET3.WK1, and so forth.

Until recently, I changed the name of each successive version of my files manually using the /File Save command. For example, to save a new version of a worksheet named BUDGET1.WK1 under the name BUDGET2.WK1, I issued the /File Save command, pressed the Spacebar, pressed Backspace twice to erase the space and the character 1, typed a 2, and then pressed Enter.

Now, I use the macro shown in Figure 1. Whenever I want to save a worksheet for the first time or save a successive version under a new name, I simply invoke this macro. It saves up to 100 versions of a worksheet.

The first statement in this macro adds 1 to the value in the cell named VERSION (B9). Originally, VERSION will be blank. But its value will increase by 1 each time you use the macro.

The second statement in this macro tests to see if the value in VERSION is equal to 100. If so, *1-2-3* will beep and then cancel the execution of the macro. If not, *1-2-3* will execute the commands in cell B3. The {If} command at the beginning of this cell checks to see if VERSION contains the value 1, as it will the first time you use the macro. If it does, *1-2-3* will execute the command {GetLabel "Name for file?", FILENAME}, which prompts the user for the name of the file and enters the response into the cell named FILENAME (B6). Although you can type up to 80 characters in response to this prompt, *1-2-3* will use only the first six. Each of these characters must be one that DOS allows in the name of a file.

The next command in this macro modifies the label in FILENAME. The first time you use this macro, *1-2-3* appends the character 1 to the first six characters in the label in FILENAME. (If the label in FILENAME contains less than six characters, *1-2-3* appends the character 1 to however many characters are in that label.) Subsequently, *1-2-3* replaces the final two characters in FILENAME with new characters. For example, *1-2-3* will replace the character 1 with the character 2 the second time you run the macro, replace the character 9 with the character 10 the tenth time you run the macro, and so forth.

After *1-2-3* modifies the label in FILENAME, it executes the statement in cell B5, which issues the /File Save command. Then, since FILENAME is the next cell of the macro, it will replace the name of the file in the control panel with the name that is currently in that cell. Then it will execute the command in cell B7, which completes the command, saving the file under its new name.—*Mickey Corrow; Bennington, Vermont*

A lot of *1-2-3* users (ourselves included) will find this macro a convenient way to save successive versions of a worksheet. The only modification that we'd make to this macro is to replace the command {Let} in cell B4 with

```
{Let FILENAME,
 @IF(VERSION=1,@LEFT(FILENAME,6),
 @LEFT(FILENAME,@LENGTH(FILENAME)-2))
 &@IF(VERSION<10,"0","")
 &@STRING(VERSION,0)}
```

The revised argument of this command instructs *1-2-3* to place the digit 0 to the left

```
     A        B          C          D          E          F          G          H
1    \e       {Let VERSION,VERSION+1}
2             {If VERSION=100}{Beep}{Quit}
3             {If VERSION=1}{GetLabel "Name for file: ",FILENAME}
4             {Let FILENAME,@IF(VERSION=1,@LEFT(FILENAME,6),@IF(VERSION<11,
              @LEFT(FILENAME,@LENGTH(FILENAME)-1),@LEFT(FILENAME,
              @LENGTH(FILENAME)-2)))&@STRING(VERSION,0)}
5             /fs
6    FILENAME
7             ~
8
9    VERSION
10
```

Figure 1: *This macro saves successive versions of a worksheet under different names.*

■ SPREADSHEET CLINIC

of the version number the first nine times you use this macro. Therefore, the names of every version of the worksheet will contain the same number of characters.

A simple *1-2-3* macro that combines macro statements

While writing *1-2-3* macros, I often need to append commands from one cell of a macro to the end of commands in another cell. I used to enter a string formula such as

```
+cell1&cell2
```

into an empty cell, where cell1 and cell2 are the addresses of the cells that contain the macro statements I wished to consolidate. Then, I used the /Range Values command to copy the result of this formula (the combined macro statement) into the cell I specified as cell1.

Now I use the macro shown in Figure 2 to automate the process of combining two macro statements. Invoke this macro while the cell pointer is on the cell that you want to append.

The first statement solicits the address of the cell that contains the label you want to append to the end of the label in the current cell. Then it places that address into the cell named ADDRESS (B5). For example, to append the label from cell B9 of a worksheet to the label in the current cell, you would type B9. Next, press Enter and *1-2-3* will enter the label 'B9 into ADDRESS.

The second statement instructs *1-2-3* to recalculate the string formula

```
+"{Let "&@CELLPOINTER("address")&",
 @CELLPOINTER(""contents"")&@@(ADDRESS)}~"
```

in the cell named NEXT. This formula returns a macro statement that tells *1-2-3* to replace the entry in the current cell with the result of concatenating the commands in the specified cell to the end of the entry in the current cell.

For example, if you invoke this macro when the cell pointer is on cell B8, the formula (in NEXT) will return the statement

```
{Let $B$8,@CELLPOINTER("contents")&
 @@(ADDRESS)}~
```

The function @CELLPOINTER("contents") in this statement will return the contents of the current cell; the function @@(ADDRESS) will return a reference to the cell whose address is stored in ADDRESS. Therefore, the concatenation formula will append the entry in the cell you specified to the end of the entry in the current cell—the cell whose address is returned by the function @CELLPOINTER("address") in the string formula in NEXT.

To demonstrate this macro, let's suppose that cell B20 of a worksheet contains the label '{End} and cell B21 contains the label '{Down}. To concatenate these two labels, you would position the cell pointer on cell B20, press Alt-C to invoke this macro, and type B21 in response to the {GetLabel} prompt. *1-2-3* would then recalculate the formula in NEXT, which, because the cell pointer was on cell B20, would return the statement

```
{Let $B$20,@CELLPOINTER("contents")
 &@@(ADDRESS)}~
```

Since the current cell contains the label '{End}, the cell named ADDRESS contains the label 'B21, and cell B21 contains the label '{Down}, this statement would place the label '{End}{Down} (the result of the formula +"'{End}"&B21) into cell B20, replacing the entry in that cell.—*Dick Gelgauda; Branford, Connecticut*

This technique should prove useful to anyone who writes *1-2-3* macros. However, this macro will produce disastrous results if either the current cell or the one whose address you specify does not contain a label. In these cases, this macro will replace the entry in the current cell with the value ERR. The same thing will happen if the cell address you specify is invalid, or if the combined length of the two labels exceeds 240 characters.

You can avoid an error by modifying the macro as shown in Figure 3. As you can see, the statement in cell B2 tests to see if the concatenation will return the result ERR. If it does, *1-2-3* will beep and cancel the execution of the macro before it re-

```
     A        B        C        D        E        F        G        H
1    \c       {GetLabel "Address of label to append to end of current label:
               ",ADDRESS}
2             {Recalc NEXT}
3    NEXT     {Let $B$4,@CELLPOINTER("contents")&@@(ADDRESS)}~
4
5    ADDRESS
6
```

Figure 2: *This macro combines commands by appending the label from the cell you specify to the end of the label in the current cell.*

```
     A        B        C        D        E        F        G        H
1    \c       {GetLabel "Address of label to append to end of current label:
               ",ADDRESS}
2             {If @ISERR(@LENGTH(@CELLPOINTER("contents")&@@(ADDRESS)))}
               {Beep}{Quit}
3             {Recalc NEXT}
4    NEXT     {Let $B$5,@CELLPOINTER("contents")&@@(ADDRESS)}~
5
6    ADDRESS
7
```

Figure 3: *This macro warns you if the concatenation will not work.*

```
     A        B        C        D        E        F        G        H
1    \c       {GetLabel "Press [Enter], then point to second label...",NULL}
2             /rncSECOND~~
3             /rndSECOND~
4             /rncSECOND~{Esc}{?}~
5             {If @ISERR(@LENGTH(@CELLPOINTER("contents")&SECOND))}{Beep}{Quit}
6             {Recalc NEXT}
7    NEXT     {Let $B$2,@CELLPOINTER("contents")&SECOND}~
8
9    NULL
10
```

Figure 4: *This macro lets you point to the cell that contains the label you want to append to the label in the current cell so that you won't have to type its address.*

places the entry in the current cell.

If you prefer to point to the cell that contains the second label, rather than typing its address, you can use the macro shown in Figure 4. Cell B7 of this macro contains the formula

```
+"{Let "&@CELLPOINTER("address")&",
 @CELLPOINTER(""contents"")&$ECOND}"
```

Since the macro names the cell that contains the second label, the @@ function is not necessary.

A one-line macro that makes *1-2-3* beep after it recalculates a worksheet

The September 27, 1988, Spreadsheet Clinic suggested a simple way to make *1-2-3* beep after it recalculates a worksheet. Although this technique works in all releases of *1-2-3*, it's not the best way if you have Release 2.0 or 2.01. In these releases you should use the {Beep} command to make *1-2-3* sound a tone. The simple one-line macro

```
\r  {Calc}{Beep}
```

causes *1-2-3* to recalculate a worksheet, then beep when it is done.

If you would like to vary the pitch of the tone that *1-2-3* sounds, you can use one of the {Beep} command's optional arguments. The argument 0 specifies a low tone; the argument 1 specifies a slightly higher tone (the same one that a {Beep} command without an argument produces); the argument 2 specifies an even higher tone; and the argument 3 specifies the highest tone that *1-2-3* is able to produce. Or, if you want to create a range of sounds, you can use them all. The macro

```
\r  {Calc}{Beep 0}{Beep 1}{Beep 2}{Beep 3}
```

sounds a series of four ascending tones after it recalculates the current worksheet.—*Tom Vis; Reston, Virginia*

This is correct—the {Beep} command does provide more flexibility for *1-2-3*, Releases 2.0 and 2.01, than the technique we presented in that issue. In addition to using arguments to control the tone produced by the {Beep} command, we often use the {Wait} command to introduce pauses between the tones. The macro shown in Figure 5 recalculates the worksheet, then triggers an alarm that sounds somewhat like a Big Ben chime.

Although the {Beep} command provides more tonal flexibility than the method we described in the September 27, 1988, issue, it is not as efficient if you want *1-2-3* to beep more than three times. For example, to make *1-2-3* beep four times after it recalculates a worksheet, you might use

```
\r  {Calc}{Beep}{Beep}{Beep}{Beep}
```

However, the macro

```
\r  {Calc}{Edit}{Right 4}{Esc}
```

does the same thing in less space.

A simpler formula for calculating the final day of successive months

In the January 31, 1989, Spreadsheet Clinic, you presented a macro that enters the serial date values of the final day of successive months into a row or column of a *1-2-3* worksheet. To calculate the serial

```
     A        B                                          C        D        E        F
1    \r       {Calc}
2             {Beep 3}{Wait @NOW+@TIME(0,0,.5)}
3             {Beep 1}{Wait @NOW+@TIME(0,0,.5)}
4             {Beep 2}{Wait @NOW+@TIME(0,0,.5)}
5             {Beep 0}{Wait @NOW+@TIME(0,0,1)}
6             {Beep 0}{Wait @NOW+@TIME(0,0,.5)}
7             {Beep 2}{Wait @NOW+@TIME(0,0,.5)}
8             {Beep 3}{Wait @NOW+@TIME(0,0,.5)}
9             {Beep 1}
10
```

Figure 5: *This macro recalculates the current worksheet, then triggers an alarm that sounds somewhat like a Big Ben chime. The {Wait} command introduces a pause between the tones.*

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```
     A        B          C          D          E          F          G          H
1    \d       {GetNumber "Starting month (1-12)? ",MONTH}
2             {GetNumber "Starting year (1988=88)? ",YEAR}
3             /rncFILLRANGE~{?}~
4             {Goto}FILLRANGE~
5             @IF(MONTH=12,@DATE(YEAR+1,1,1)-1,@DATE(YEAR,MONTH+1,1)-1)~
6             {Down}
7             +{Up}+32-@DAY({Up}+32)~
8             /c~{Down}.{Down @ROWS(FILLRANGE)-3}~
9             {Up}
10            /rfd1{End}{Down}~
11            /rv{End}{Down}~~
12
13   MONTH
14   YEAR
15
```

```
     A        B          C          D          E          F          G          H
1    \d       {GetNumber "Starting month (1-12)? ",MONTH}
2             {GetNumber "Starting year (1988=88)? ",YEAR}
3             /rncFILLRANGE~{?}~
4             {Goto}FILLRANGE~
5             @IF(MONTH=12,@DATE(YEAR+1,1,1)-1,@DATE(YEAR,MONTH+1,1)-1)~
6             {If @COLS(FILLRANGE)>1}{Branch COLUMNS}
7             {Down}
8             +{Up}+32-@DAY({Up}+32)~
9             /c~{Down}.{Down @ROWS(FILLRANGE)-3}~
10            {Up}
11            /rfd1{End}{Down}~
12            /rv{End}{Down}~~
13
14   COLUMNS  {Right}
15            +{Left}+32-@DAY({Left}+32)~
16            /c~{Right}.{Right @COLS(FILLRANGE)-3}~
17            {Left}
18            /rfd1{End}{Right}~
19            /rv{End}{Right}~~
20
21   MONTH
22   YEAR
23
```

Figure 6: *The two macros shown above are improved versions of the macros shown in Figures 1 and 2 in Spreadsheet Clinic, January 31, 1989. They implement a simpler formula to calculate the final day of successive months in a* 1-2-3 *worksheet.*

date value of each successive month, that macro uses the formula

```
@IF(@MONTH(cell)=11,
@DATE(@YEAR(cell)+1,1,1)-1,
@IF(@MONTH(Cell)=12,
@DATE(@YEAR(cell)+1,2,1)-1,
@DATE(@YEAR(cell),@MONTH(cell)+2,1)-1))
```

where `cell` is the address of the cell that contains the serial date value of the final day of the previous month.

Although this formula works, it is more complex than it needs to be. The simple formula

```
+cell+32-@DAY(cell+32)
```

returns the same result.

As in the original formula, `cell` is the address of the cell that contains the serial date value of the previous date in the series (the final day of any month). This revised formula first adds the value 32 to the previous date in the series—a date that represents the last day of a month. This portion of the formula will always return the serial date value of the first, second, third, or fourth day of the second month after the previous month.

For example, suppose the cell referenced by this formula contains the serial date value of December 31, 1988. The first part of this formula will then return the serial date value of February 1, 1989. If the cell referenced contains the serial date value of March 31, 1989, the first part of this formula will return the serial date value of May 2, 1989. If the referenced cell contains the serial date value of January 31, 1988, this part of the formula will return the serial date value of March 3, 1988, and so forth.

The second part of this formula returns the day component of the serial date value returned by the first part of the formula—either 1, 2, 3, or 4. For example, if the first part of the formula returns the serial date value of February 1, 1989, the second part will return the value 1; if the first part of the formula returns the serial date value of May 2, 1989, the second part will return the value 2, and so on.

Subtracting the result of the second part of the formula from that of the first returns the serial date value of the last day in the month that immediately follows the date in the cell that is referenced by the formula. So if the formula references a cell that contains the serial date value of December 31, 1989, it will return the serial date value of January 31, 1989—the result of subtracting 1 from the serial date value of February 1, 1989. If the formula references a cell that contains the serial date value of March 31, 1989, it will return the serial date value of April 30, 1989—the result of subtracting the value 2 from the serial date value of May 2, 1989.—*Thomas P. Eggharter; San Luis, Argentina*

This formula is indeed simpler than the one we printed in that issue. To modify the macro in Figure 2 of that issue, simply replace the label in cell B7 with

```
B7:  '+{Up}+32-@DAY({Up}+32)~
```

as shown in the first macro in Figure 6. To modify the macro in Figure 3 of that issue, replace the formula in cell B8 with

```
B8:  '+{Up}+32-@DAY({Up}+32)~
```

and the formula in cell B15 with

```
B15:  '+{Left}+32-@DAY({Left}+32)~
```

respectively. It is shown here as the second macro in Figure 6. You can use this formula outside the context of a macro.

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USER-TO-USER



Changing your video mode without using DOS's MODE command; a QUIT command for batch files; doing quick calculations using BASIC; avoiding a bug in an EDLIN script.

Here's one way to make sure all your disk copies are *good* copies

From time to time I have to distribute multiple copies of custom-written laboratory software. Of course, I want to be sure that every disk contains an error-free copy of the software. The simplest method normally is to use a two-floppy-disk-drive system, always making copies from the previous copy and then testing the final disk. If the last disk is OK, then all of the intermediate ones must also be OK.

However, many computer users now have systems with only one floppy disk drive, or two drives of different sizes, preventing the simple method of checking multiple copies. The batch file, DBACK.BAT, shown in Figure 1, can perform a similar process in any system using a transfer disk of any type (a RAMdisk is recommended).

First, copy the original files to the transfer disk (a RAMdisk assigned as D:, for example) and place a formatted disk in the appropriate floppy disk drive (for example, drive A:). Then enter a command in the format

```
DBACK D: A:
```

The batch file will copy the files from the RAMdisk to the floppy disk in drive A:. Then it will copy the copied files back to the RAMdisk for the next floppy disk. Last, it checks for (and removes) the batch file from the copied disk. When a series of copies are created by this method, if the last disk of the series shows no errors when tested, then all of the disks are OK.

—Jeff Peterman; Birmingham, Alabama

Copying disks isn't like photocopying documents—disk files don't fade as you make copies of copies of copies. In fact, a copy can be better than the original, since its magnetic recording is fresh while the original may have faded somewhat with age. Some cautious computer users routinely recopy aging disks onto themselves, to refresh the magnetic impression.

If errors during copying were common, you wouldn't want to use this method. Finding errors in the final disk means you must test *all* disks and recopy any made after the error occurred. That's rarely necessary—it's just a final fail-safe test.

Make BASIC do quick calculations for you

CALC.BAT, shown in Figure 2, lets you evaluate numeric expressions quickly and easily. It turns the expression you enter as a parameter into a short BASIC program and runs it. When the program is finished, it returns to DOS automatically. Any valid BASIC expression is also valid here.

This short batch file uses the ECHO command to write the program by redirecting output to a file. Because ECHO limits output to 122 characters, the input expression is limited to 100 characters.

CALC.BAT will display the equation along with the answer if you use # as a

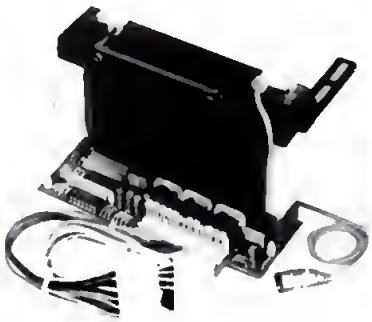
```
ECHO OFF
REM DBACK.BAT
ECHO #============================================================#
ECHO Initiate routine by typing DBACK [TRANSFER DRIVE] [TARGET DRIVE]
ECHO Include full drive/path information, e.g. DBACK C:\temp A: after
ECHO copying the original disk and this batch file into C:\temp
ECHO #============================================================#
IF (%2)==() GOTO END
IF (%1)==(%2) GOTO END
:START
ECHO Set up to use %1 as Transfer Drive and %2 for Copies
ECHO ------------------------------------------------------------
ECHO Insert a new formated disk in drive %2 or use Ctrl-C to quit.
PAUSE
COPY %1*.* %2
COPY %2*.* %1
ERASE %2DBACK.BAT
ECHO ^G
REM Previous line should be ECHO ^G, generating ^G (BEEP) by Ctrl-G.
ECHO ------------------------------------------------------------
ECHO Copying complete.
ECHO ------------------------------------------------------------
GOTO START
:END
ECHO Error in command line parameters.
```

Figure 1: *When you copy multiple disks with this batch file, you have to test only the last one.*

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■ USER-TO-USER

```
ECHO OFF
REM  CALC.BAT
CLS
IF "%1"==""  GOTO no_expression
IF "%2"==""  GOTO just_answer
IF "%2"=="#" GOTO show_equation
GOTO error
:just_answer
ECHO 1?"Ans= ";%1:SYSTEM>Q.X
GOTO continue
:show_equation
ECHO 1?"%1= ";%1:SYSTEM>Q.X
:continue
IF NOT EXIST Q.X GOTO error
BASICA Q.X
ERASE Q.X
GOTO end
:error
ECHO Sorry, an error has occurred --- please check your equation.
ECHO Max len= 100.  If you enter '#' (w/o quotes) as a second
ECHO parameter, the maximum len= 50.  You may not put any spaces
ECHO in your equation.
IF EXIST Q ERASE Q
GOTO end
:no_expression
ECHO No expression was specified!
:end
```

Figure 2: *CALC.BAT evaluates any expression that's valid in BASIC.*

second parameter. When this is done, however, the expression is limited to 50 characters.

To evaluate 4*33+(2^11)/sin(31), for example, you would type

```
CALC 4*33+(2^11)/sin(31)
```

and CALC.BAT would respond

```
Ans= -4936.835
```

If you type

```
CALC 4*33+(2^11)/sin(31) #
```

CALC.BAT responds

```
4*33+(2^11)/sin(31)= -4936.835
```

There are some things you should note. First, you must have BASIC available to CALC.BAT. Either hard-code its location in the batch file or put its directory on your path. Second, the expression can't contain imbedded spaces. Anything following a space is taken as a second parameter.

Choose a name that another program is very unlikely to have. The name I gave to the program is Q.X. (Note: BASIC programs do *not* have to have the .BAS extension.) And last, the program is created in the current directory. It is no more than 120 bytes in size, and it's erased immediately after being run.

If the expression is too long, one of two things can happen. If it's just one or two characters too long, the program is saved under the name Q with no extension and is erased in the error section of the program if it exists. But, if the expression is even longer, the program is not saved. It is displayed directly on the screen.—*Randy J. Guyan; Johnstown, Pennsylvania*

In the February 16, 1988, issue we showed a CALC.BAT program that also used BASIC to perform calculations. That batch file piped input into BASIC and filtered the output with FIND to display only the answer line. This new CALC.BAT also uses BASIC, but since it actually writes and runs a small program, it has better control over the output.

A couple of the statements in the above text need further explanation. It's not ECHO that limits the length of the expression, it's the nature of DOS command lines. Any command line can have no more than 127 characters. Subtract 4 characters for the word ECHO and 1 for the space that follows it and you get 122.

If you do enter an expression that's too long, it will cause a problem in the line

```
ECHO 1?"Ans= ";%1:SYSTEM>Q.X
```

At runtime, the %1 in this line is replaced by the first parameter on your command

line. If the resulting line is longer than 127 characters, you'll lose characters from the end. If you lose just the X, or the period and the X, output will go to a file called Q. If you lose *exactly* the letters Q.X, you'll get a File Creation Error as DOS tries to redirect output without a filename. Lose any more characters and you'll just see 127 characters of the expanded command on-screen, followed by an error message.

Since BASIC initializes variables, a slip of the finger can cause surprising results. If you type CALC 2*R when you mean to type CALC 2*4, you'll get 0 as an answer. BASIC interprets R as a new variable and sets its value to zero. Whenever your expression is less than 50 characters, use the second parameter # so the actual equation will be displayed on-screen. Note also that if you enter an invalid operation such as CALC C++, the BASIC program will halt and you'll have to type SYSTEM to get out.

A missing letter in an EDLIN script disabled the batch file

I enjoyed reading your tip on disassembling .COM files in the January 31, 1989, issue of *PC Magazine*. However, there is an error on page 280 in Figure 3, the DISASM.EDL listing: line 2 is missing a U (after the ^Z). If you use this script without the U, EDLIN doesn't modify DISASM.TMP to include the proper input commands for DEBUG. Running DEBUG with the mismodified DISASM.TMP file produces a .LST file 0 bytes long. The DISASM.EDL listing should read as follows:

```
4R-
2RCX^ZU 100 L
3D
1D
E
```

Also, the CX in this line *must* be entered in uppercase. Otherwise, EDLIN will issue a "Not found" message instead of replacing the text. DEBUG's output to the DISASM.TMP file is in uppercase and EDLIN's replace command is case sensitive. Although you used uppercase in your example, many of us use lowercase.

I also modified DISASM.BAT slightly. I load all of my batch files to a RAM-disk and specify a path statement to it when I boot. With my version of DISASM

```
DEBUG %1.COM < C:\UTILITY\DISASM.SCR > DISASM.TMP
EDLIN DISASM.TMP < C:\UTILITY\DISASM.EDL
DEBUG %1.COM < DISASM.TMP | FIND ":" > %1.LST
DEL DISASM.TMP
```

Figure 3: *This new version of DISASM.BAT can be used from any subdirectory.*

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■ USER-TO-USER

.BAT, I can start the batch file from any drive or directory and specify the subdirectory I want the output file to go to. However, if DISASM.EDL, DISASM.SCR, or the .COM file to be disassembled is stored in the target directory, they must be read-only files or they'll be deleted.—*Scott W. Sovereign; Dothan, Alabama*

Yes indeed, somewhere in the process of getting the article to print, an important U dropped out of that figure. Without it the collection of files doesn't work. In the text, the line is described correctly, with the U in place. A number of readers noticed the discrepancy.

Regarding the comment about upper- and lowercase, your safest bet is to copy listings *exactly*. Sometimes case isn't important, but unless you are quite sure, type CX as CX, not as cx.

The modified DISASM.BAT file Mr. Sovereign submitted was more "dangerous" than it needed to be. As he states, it can delete your carefully created DISASM .EDL and DISASM.SCR files or even the *.COM file you're attempting to disassemble. I replaced it with the file in Figure 3. If the DISASM.EDL and DISASM.SCR files reside in the UTILITY subdirectory, and if DISASM.BAT, DEBUG, and EDLIN are on the path, the modified file will disassemble .COM files in any directory.

QUIT from your batch file rather than GOTO End

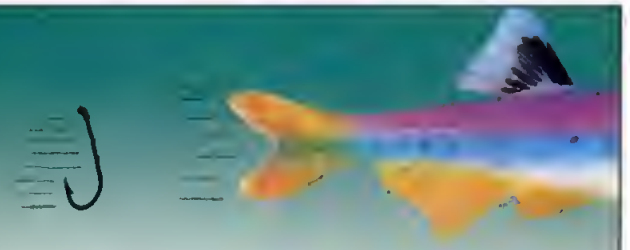
The October 31, 1988, issue featured a batch file technique that allows conditional branching. With some changes, I incorporated it into my AUTOEXEC.BAT file.

My AUTOEXEC file contains 30 separate commands, not including the SHFTPICK series. Not all of these commands load RAM residents. I sometimes want my computer to boot without loading RAM residents, but I usually want my path set, and the current subdirectory in the prompt. Therefore, my file reads

```
ECHO OFF
CLS
PATH
...
SETCLOCK
PROMPT $P$G
SHFTPICK
IF ERRORLEVEL 8 IF NOT ERRORLEVEL 9 GOTO ECHO
...
...
...
<<last command>>
:ECHO
ECHO Your path is set, but no RAM residents are
 loaded!
```

If I press Alt during AUTOEXEC, it will jump to the end and automatically returns me to DOS after the reminder message is typed. When I do *not* press Alt, AUTOEXEC will reach the *<<last command>>*. If this is a batch file, AUTOEXEC will terminate. Any batch file will do, even a simple one that just ECHOs a message.—*Henry Farkas; New Haven, Connecticut*

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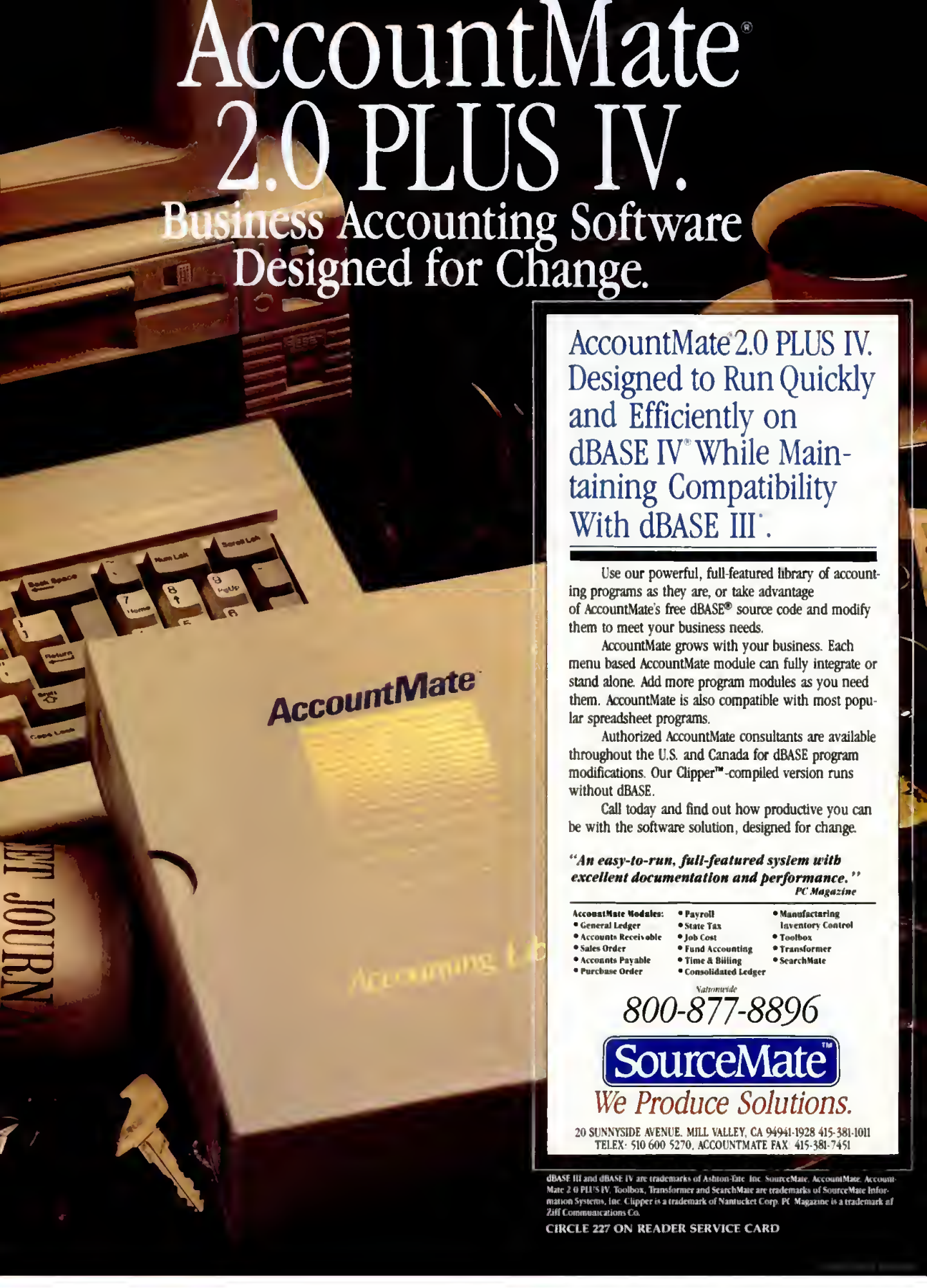


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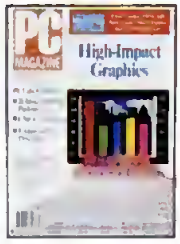
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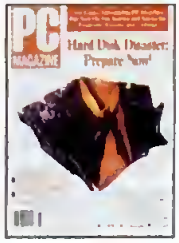
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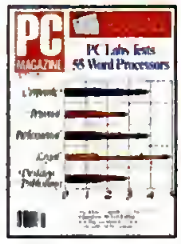
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■ USER-TO-USER

Most branching batch files are liberally sprinkled with lines like "GOTO End" or "GOTO Done." Often the label :End or :Done is the very last line in the file. What's really needed here is a QUIT command, something that will just end the batch file. Mr. Farkas has hit on the right idea—running another batch file stops execution of the first batch file.

A batch file, no matter how small, takes up at least one cluster of disk space, usually 2K or 4K. That's not entirely true. A batch file of *zero* length takes no space, yet running such a file still stops the current batch file's execution. To give yourself a QUIT command for batch files, create a zero-length QUIT.BAT file and keep it in a directory on your path. A previous User-to-User tip told how to create such a file

```
TYPE QUIT.BAT > QUIT.BAT
```

For those who didn't see it in the October 31, 1988, issue, SHFTPICK is a tiny program that generates an ERRORLEVEL code based on the state of the Shift keys. In the example above, holding down the Alt key during execution of AUTOEXEC.BAT sets the ERRORLEVEL to 8, and the IF statement causes a jump to the label :ECHO.

For the price of some RAM, you can SET COMSPEC in DOS 2.0

In the August 1988 issue's PC Tutor, Robert L. Hummel stated that the COMSPEC variable is properly set at boot time in DOS 2.0, but changing its value will not cause DOS to reload from the pathname specified in it. In order to overcome this inconvenience, I have found a simple technique. If you want DOS to reload from drive C: copy COMMAND.COM to drive C: and enter

```
A>C:COMMAND C:
```

or enter the following:

```
C>COMMAND C:
```

This will actually start a second copy of COMMAND.COM within the running copy of COMMAND.COM, as with the BASIC SHELL command. You can see that the COMSPEC variable has changed accordingly by using the SET command. Admittedly, this isn't very efficient, as both copies stay in memory.

You can do the same with subdirectories. Copy COMMAND.COM to the directory A:\CMND and enter

```
A:\CMND>COMMAND A:\CMND
```

However, when you execute COMMAND.COM, the current directory must be the same as the one in which you want DOS to look when reloading. No matter what I did, I couldn't execute anything in a directory other than the current one in DOS 2.11.—*Oktay Ahiska; Ankara, Turkey*

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■ USER-TO-USER

If you have only two floppy disks, it's handy to copy COMMAND.COM to a RAMdisk and set COMSPEC to point to it. After running any large program, DOS needs to reload the transient portion of COMMAND.COM, so the file must be accessible. Unfortunately, setting the COMSPEC environment variable does not cause DOS 2.0 to find the copied COMMAND.COM. But running the new COMMAND.COM with its own drive and directory as a parameter *does* work. *If* you can afford the RAM cost, that is.

Regarding the comment about not being able to run anything in a directory other than the current one, that's how DOS 2.0 works. It was only with the introduction of Version 3.0 that we gained the ability to run a program that's neither in the current directory nor on the path.

Two ways to change your video mode without using MODE.COM

PC users with CGA monitors may find they can't fit DOS's MODE command on a single disk. When this happened to me, I wished that I could chop up the program and copy just the video mode features. Another disadvantage of DOS's MODE command is that I'd forget the syntax and have to look it up.

```
A 100
MOV     AH,F
INT 10
CMP AL,7
JZ 121
MOV AH,9
MOV DX,123
INT 21
MOV AH,8
INT 21
CMP AL,30
JL 10F
CMP AL,36
JG 10F
SUB AL,30
MOV AH,0
INT 10
INT 20

E123 0D 0A 0A 0A 09
E 128 "0. 40 COLUMN; B&W"
E 139 0D 0A 09
E 13C "1. 40 COLUMN; COLOR"
E 14F 0D 0A 09
E 152 "2. 80 COLUMN; B&W"
E 163 0D 0A 09
E 166 "3. 80 COLUMN; COLOR"
E 179 0D 0A 09
E 17C "4. 320 BY 200 GRAPHICS; COLOR"
E 199 0D 0A 09
E 19C "5. 320 BY 200 GRAPHICS; B&W"
E 1B7 0D 0A 09
E 1BA "6. 640 BY 200 GRAPHICS; B&W"
E 1D5 0D 0A 0A 0A 24
RCX
DA
N NUMODE.COM
W
Q
```

Figure 4: *NUMODE.DBG creates NUMODE.COM, a mini-MODE that controls only the video mode.*

When I learned assembly language, I wrote NUMODE.COM to combat this situation. It takes up the smallest possible room on a floppy disk and is almost self-explanatory.

When you execute the program, it first checks to see whether you're in monochrome mode. If you are, it exits as a safety precaution. If not, NUMODE.COM displays a menu of the seven display modes for the CGA. Once you press one of the number keys displayed, it activates that mode instantly.

The program is created by the script file NUMODE.DBG, shown in Figure 4. To create NUMODE.DBG, copy the DOS program DEBUG to the disk with the script file, insert the disk in the default drive, and type

```
DEBUG < NUMODE.DBG
```

The information required to make the program will flash by, and if you created the file correctly (with a carriage return after the Q), the program NUMODE.COM will be created.—*Michael Baer; San Jose, California*

If you have never experienced the problem described here, you probably have a hard disk. Floppy disk users have to worry about the external DOS programs being available, and MODE *is* an important command. For example, a surprising number of programs leave the color turned off when they exit, requiring a MODE CO80 command.

```
ECHO OFF
REM ANSIMODE.BAT
FOR %%x IN (0 1 2 3 4 5 6) DO IF "%%x"=="%1" GOTO OK
ECHO SYNTAX "%0 #" where # is one of:
ECHO 0. 40 Column; B&W
ECHO 1. 40 Column; Color
ECHO 2. 80 Column; B&W
ECHO 3. 80 Column; Color
ECHO 4. 320 by 200 Graphics; Color
ECHO 5. 320 by 200 Graphics; B&W
ECHO 6. 640 by 200 Graphics; B&W
GOTO End
:OK
SET PROM=%PROMPT%
PROMPT $e[%1h
ECHO ON
ECHO OFF
PROMPT %PROM%
SET PROM=
:END
```

Figure 5: *ANSIMODE.BAT uses ANSI commands to set the video mode.*

NUMODE.DBG is a little more complicated than our usual DEBUG scripts in User-to-User, but it's worth trying. The script is in two main parts, separated by the blank line after INT 20. The first part is the program code, and the second part is the menu display. As usual, you must type in the script *exactly* or the resulting program may not work correctly. Note that there is just one space after the period in each of the menu lines.

A DEBUG script this large is pretty heady stuff. If you don't want to try it and you have ANSI.SYS loaded, use ANSIMODE.BAT (Figure 5). It performs the same task as NUMODE.COM, but by using only a batch file.

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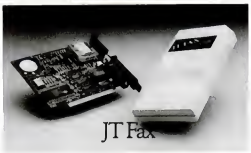
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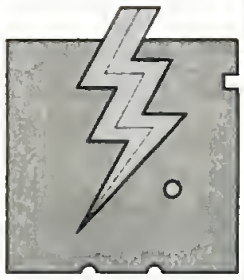
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I've devised a pair of "minimacros" in *WordPerfect* 5.0 that I use dozens of times every day. Alt-P types an opening parenthesis and pauses for user input. Then, when the user presses Enter, Alt-P supplies the closing parenthesis. A similar macro, Alt-' (think *Alt-"*), does the same thing with quotation marks. These macros use the {PAUSE} programming command, accessed with Ctrl-PgUp, to permit additional keyboard input before the closing parenthesis or quote.

The particularly convenient thing about these macros is the way they nest within each other. I'm an attorney, and I find this extremely handy when preparing a letter to a client about IRS regulation I.103-10(b)(2)(iv)(b), or when introducing short forms at the beginning of an "Agreement between ABC Company (the "Company") and XYZ Bank (the "Bank") . . . " In typing the above quotation, I embedded pairs of quotes within the two pairs of parentheses, both of which were embedded within a pair of quotes. The macros always remember whether I need a quote or a parenthesis when I hit Enter.

When mapped to the appropriate key using the keyboard layout facility, these macros appear as follows:

```
Alt-P ({PAUSE})
Alt-' "{PAUSE}"
```

Alt-' must be a keyboard layout macro, since regular Alt-key macros only work with alphabet keys. Alt-P could be mapped to Alt-9 (think *Alt-(*), but I wanted to preserve Alt-9 for "{VAR 9}". Besides, part of the convenience of these macros comes from staying off the top row of the keyboard, which is outside the touch-typing zone for some of us. People who have to write about macros might feel the need for similar macros; for example, Alt-Comma (think *Alt-<*) and Alt-[.—*James R. Breckenridge; New York, New York*

These *are* useful tiny macros, and I'm already using the Alt-Comma macro to create the angle brackets for keynames. They're not *quite* as powerful as their author suggests—there's a limit of six levels of nesting. (You can prove this by pressing Alt-P six times, then Alt-' six times, any word, and then Enter six times. Instead of closing the six open quotes, you've closed the parentheses, and pressing Enter again gives you a hard carriage return.) However, it's not likely that you'll need more than six levels of nesting.

Do note that combinations like Alt-' and Alt-Comma require an Enhanced keyboard. On an unenhanced keyboard, you'll have to choose other key combinations.—*Neil J. Rubenking*

Creating running header setups with multiple positions in *Microsoft Word* 4.0

Because *Word* allows running headers to extend beyond the Division Margins, determining the correct settings if you want some material on the left margin, some centered, and some right-justified can be difficult. Figure 1 shows a macro that handles all these calculations—in this case, placing the revision date on the left, centering the title, and making the page number right-justified.

The first four lines of the macro read the current margin settings and page width from the Format Division Margins screen, and the next four enter the header itself, using tabs to mark position. The header is then formatted as a running head. Finally, lines 11 through 14 use the page-width and margin settings from lines 1 through 4 to calculate the tab positions.

Note that you can also prompt for the title by replacing the <tab>TITLE with

```
<tab>«ask T=?Type title»«T»
```

```
<ctrl esc>fdm<tab 2>
«set LM=field»
<tab>«set RM=field»
<tab 2>«set PW=field»
<esc><ctrl pgup>
<tab>dateprint<f3>
<tab>TITLE
<tab>Page page<f3><enter>
<left><f10>
<esc>fr<tab 3>y<enter>
<esc>fts
«LM»<ins>
«PW-RM»<tab>r<left><ins>
«LM+0»<tab>c<enter>
```

Figure 1: *This* Word *macro automatically sets up a three-position header, with the revision date of the file on the left, the page number on the right, and the title centered.*

in line 7 of the macro.—*Rexford H. Swain; Washington, Connecticut*

The macro in Figure 1 assumes that you want the header's left and right margins to match those of the body of your text. This is not always so, but you can easily adjust the macro while still using the same underlying approach. For example, if you want the heading to extend ½ inch beyond the text margins on both left and right, simply define the left tab (line 12) as <<LM+0>> and the right margin (line 13) as <<PW-RM-(.5)>>.

Note that the value of the adjustment is exactly the opposite of what you would expect. For example, you would think that a left margin of 1 plus .5 would give a tab setting of 1.5, not .5. Nonetheless, the plus value is what gives you the result you want.—*M. David Stone*

Here's a *WordPerfect* way to insert a variety of repeated phrases into your documents

If you type long documents that contain repeated words or phrases, these two *WordPerfect* 5.0 macros are very helpful. You enter the text segments in Document 2, using the Fast Text Set Up Macro. Hard returns separate each text segment from the next. When you need them, the saved text segments are recalled sequentially by repeatedly hitting the single open quote key (`). You install the macros as keyboard layout macros, with the vertical bar ( | ) associated with the Set Up Macro and the single open quote (`) associated with the Fast Text Macro.

The two named macros you must create are FT_SETUP.WPM (shown in Figure 2) and FT.WPM (Figure 3). Then use the Keyboard Layout feature in Setup to put these macros in a keyboard layout. The keystrokes that do this are

```
<Shift-F1>656|FT_SETUP6`FT<F7><F7>
```

While there are many other ways to enter repeated text, this technique allows already-defined text segments to be entered with a single key. Furthermore, the text segment can be saved in a separate file if the document cannot be completed in a single session.—*Samuel Karp; Chicago, Illinois*

As long as you never need to use the piping symbol or the single open quote key, you can safely use the Keyboard Layout function to assign macros to them. If you *do* need those keys, however, either select some unused keys or simply use ordinary macros. It will take a little time to get used to using | and `, but they *will* speed your writing if you use many repeated words or phrases.

When you're about to type a phrase you'll want to use again and again, hit | to call up FT_SETUP. Type the phrase in Doc 2 and hit Enter—it will appear in Doc 1. Of course, you can also just switch to Doc 2 and type whatever phrases you want, one per line, with a hard return [HRt] at the end of each.

To get one of your phrases, press ` and just keep tapping it until the phrase you want appears. Now go on typing. If you want to quit without selecting a phrase, just step through to the end. Don't press F1 to quit the macro, however, because you'll end up with a phrase in your text.—*Neil J. Rubenking*

```
{Switch}{Home}{Home}{Down}{PAUSE}{Enter}
{Block}{Left}{ON NOT FOUND}{CALL}First_Entry~~
{Search Left}{Enter}{Search}
{Move}12{Switch}{Enter}
{Search}{Enter}{Search}{Backspace}{QUIT}
{LABEL}First_Entry~
{Home}{Home}{Up}{RETURN}
```

Figure 2: *This* WordPerfect *macro adds a word or phrase to Doc 2 and then inserts it into Doc 1.*

```
{DISPLAY OFF}{Switch}{Home}{Home}{Up}
{LABEL}Get_Next~
{ON NOT FOUND}{GO}Not_Found~~
{Block}{Search}{Enter}{Search}
{Move}12{Switch}{Enter}
{Block}{Enter}{DISPLAY ON}
{CHAR}1~Enter·`·or·next·character:·~
{IF}"{VAR 1}"="`"~{GO}Wrong_Text~{ELSE}{GO}Right_Text~{END IF}
{LABEL}Right_Text~
{Block}{Backspace}{VAR 1}{QUIT}
{LABEL}Wrong_Text~
{DISPLAY OFF}{Del}Y{Switch}{GO}Get_Next~
{LABEL}Not_Found~
{Block}{Switch}{QUIT}
```

Figure 3: *Used in conjunction with the macro in Figure 2, this macro lets you flip through your repeated phrases with the single open quote key and select one for insertion.*

Using memory variables makes it easier to set *dBASE* colors for different monitors

The strings of letters used to specify the colors with *dBASE*'s SET COLOR TO

```
*** SETCOLOR.PRG

PUBL clr_std, clr_head, clr_brit
PUBL clr_blnk, clr_warn

*** For EGA/VGA monitors:
clr_std  = "BG+/N,W+/B,N"
clr_head = "W+/R"
clr_brit = "W+/G,"
clr_blnk = "BG+*/N,"
clr_warn = "W+*/R"

*** For CGA monitors:
clr_std  = "GR+/N,W+/B,N"
clr_head = "N/GR"
clr_brit = "W+/G"
clr_blnk = "RB*/N"
clr_warn = "W*+/R"

*** For monochrome:
clr_std  = "W/N,N/W,N"
clr_head = "U"
clr_brit = "W+/N"
clr_blnk = "W*/N"
clr_warn = "U*+"
```

Figure 4: *The SETCOLOR program above gives recommended* dBASE *"SET COLOR TO" memory variable sets for different types of monitors.*

command are difficult to remember. Since I use this command frequently, I've found it makes life easier to use memory variables to hold the various color setups I plan to use in the program.

For example, suppose you want to paint the screen using different colors for normal text, headings, and flashing messages. You would initialize these memory variables as PUBLIC at the start of the program thus:

```
PUBLIC normal, header, flash
normal="SET COLOR TO GR+/B,B/GR,N"
header="SET COLOR TO B/GR,GR+/B,N"
flash ="SET COLOR TO B*/GR,GR+/B,N"
&normal
```

Now, whenever you want to change screen colors, you just type in the following lines:

```
&header
@ 1,10 SAY "Column heading:"
&normal
@ 3,10 SAY "Regular text"
```

When modifications are needed for individual color settings, the program code is much easier to see and fix. And if the program needs to run with a different kind of display adapter or video monitor, only the setup strings at the top of the program need be changed.—*Omar S. Al-Abdullatif; Riyadh, Saudi Arabia*

Figure 4 shows the settings I use for EGA, CGA, and monochrome monitors. For greater code clarity—and to ensure that the commands will work with *Clipper*—I don't store the words "SET COLOR TO" as part of the memory variable. Instead, I issue them as part of each command line thus:

```
SET COLOR TO &clr_std
```

The syntax shown above also makes it easy for you to do a global search for all color-changing commands. Furthermore, if you adopt the convention of naming all color memory variables to start with the same letters, you will find it much easier to store these—and only these—memory variables into a .MEM file if you want.

If you're using *dBASE III* rather than *dBASE III PLUS*, you should substitute "B" for "black" instead of "N" for "no color". *Clipper* users will also want to add a setting for the "unselected color," which is very useful in a series of GET statements.—*Brad Stark*

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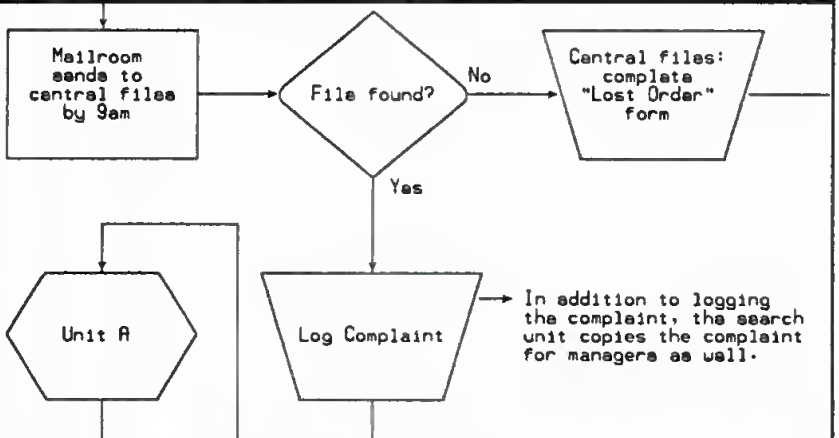
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■ POWER USER

A *Word* 4.0 envelope macro for the Canon LBP-8II and other non–Hewlett-Packard printers

PC Magazine's recent collection of envelope macros (December 13, 1988) focused on the HP LaserJet to the exclusion of other printers. Here is a *Microsoft Word* 4.0 macro that works with the Canon LBP-8II:

```
<ctrl Esc>c<del><Esc>wsh10<Tab>y
<Esc>tlc:\word\env.doc
<Down><ins><esc>pp<Esc>wc2<Enter>n
```

To use the macro, you must first create a document called ENV.DOC. Format the file with the Format Division Margins command to set top, bottom, and right margins to 0 inches, the left margin to 4.5 inches, Page Length to 8.5 inches, and Page Width to 11 inches. The first—and *only*—line of ENV.DOC contains the landscape command for the printer. The Canon command is

```
<esc>[1%r
```

You create the escape code in *Word* by holding down the Alt key, typing 27 on the numeric keypad, then releasing the Alt key. The rest of the command can be entered from the typing keys. Be sure to end this line with a Return. Note that setting the printer to landscape at the control panel can't substitute for using the landscape command, because *Word* resets the printer before printing.

The macro assumes that besides having ENV.DOC ready, you have already highlighted the address and loaded an envelope in the printer when you start the macro. The macro copies the address to the scrap, opens a window, loads ENV.DOC into the new window, inserts the address (starting the line below the landscape command), prints the envelope, and then closes the window.

Please note that you can use the macro regardless of the current Transfer Options setting—but only if you enter the full path name of ENV.DOC in the macro. —*Michael Mele, New York, New York*

Judging by the number of letters we get whenever we run an envelope macro for *Word*, there are almost as many ways to automatically address an envelope as there are users of the program. The notable feature in this version is how it uses the landscape command.

LaserJet users don't have to worry about the landscape command. *Word* provides a separate .PRD file for landscape printing, and it's easier to create a macro that changes .PRD files than it is to worry about the command you send to the printer. However, if your printer does not emulate the LaserJet—or doesn't emulate it well enough—you can't take that route. The advantage to Mr. Mele's macro is that it will work not only with the Canon LBP-8II, but with any laser printer that offers a landscape command: simply change the first line in ENV.DOC to the appropriate command for your printer.

Be aware that for the Canon LBP-8II, changing the page width and page length for landscape printing makes no difference in the location of the address on the envelope. Mr. Mele uses the same margin settings that I prefer, but you may want to adjust these to your own taste.

Finally, Figure 5 shows an alternative approach to envelope macros. This macro assumes you are using a standard division setting in your letter and requires a style sheet called ENVELOPE.STY. The standard division in ENVELOPE.STY should be formatted with the same margin settings as ENV.DOC in Mr. Mele's approach. The macro also requires another glossary entry, called landscape, which contains your printer's landscape command.

The macro starts by reminding you to save your work (always a good idea). It then reminds you to place the envelope in your printer and asks you to place the cursor on the first line of the address. After automatically highlighting five lines, it stops to let you adjust the highlight as needed.

Everything else is automatic: The macro copies the address to the end of your document, formats the address as a standard paragraph, and inserts the landscape command (by expanding the landscape glossary entry). It then reads the current stylesheet name, stores it to the variable Sheet, loads ENVELOPE.STY, prints the envelope, and deletes the address from the end of the letter. Finally, it restores your style sheet to the one you started with.

Assuming that you have the proper command entered in the landscape glossary entry, this macro, too, will work with any laser printer that has a landscape mode. The key difference between this macro and Mr. Mele's is that the former uses style sheets instead of opening additional windows. This has the advantage of letting the macro work even if you have more than one window open when you invoke it. However, if you prefer Mele's approach, you may want to combine his macro with the first few lines of this macro in order to automate the process of highlighting the address.—*M. David Stone*

```
«pause REMINDER: HAVE YOU SAVED YOUR WORK?  Hit RETURN.»
«pause Place Envelope in Printer, and Hit Return»
«pause Place cursor on the first line of the address and Hit Return»
<Home><f6><f10 5>
«pause Highlight the full address and Hit Return»
<esc>c<enter><ctrl pgdn><ins><shift f1><shift f1>
<alt s>plandscape<f3>
<enter><up><F6><ctrl pgdn>
<esc>fsa«set sheet=field»c:\word\envelope.sty<enter>
<esc>po<down 1>1<down 2>s<enter>p
<left><right><f6><Ctrl pgdn><del>
<esc>po<down 3>e<enter>
<ctrl esc>fsa«sheet»<enter>
```

Figure 5: *This* Microsoft Word *macro automatically highlights the address and prints it on a non-HP laser printer.*

Share Your Power

Tell fellow users your latest technical tips for hardware and software applications (other than spreadsheets, networks, languages, or DOS) through Power User. We'll pay $50 or more for any tips we print, *plus an extra $25 if you submit your letter on-disk.* If you do, please include a printed copy. Mail contributions to Power User, *PC Magazine,* One Park Avenue, New York, NY 10016 or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Utilities column).

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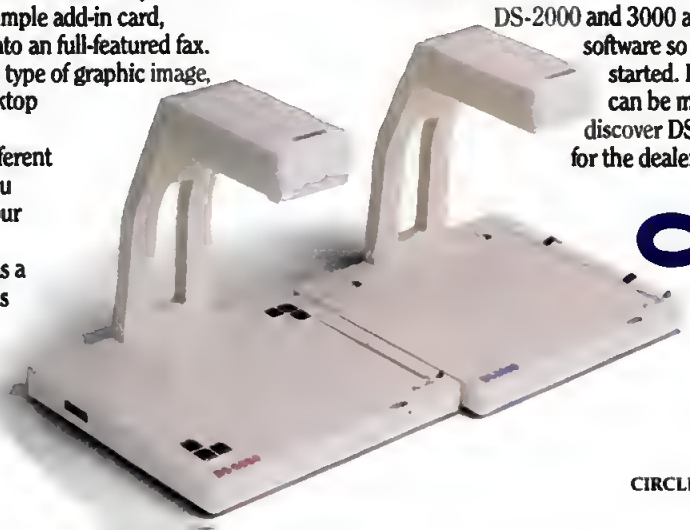


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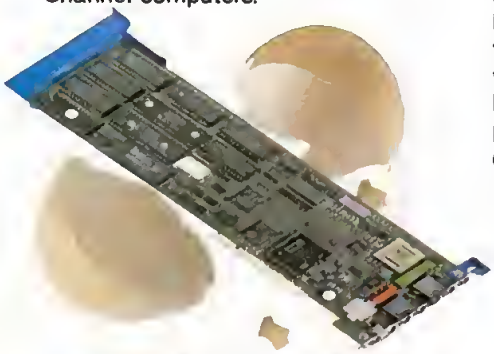
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CONNECTIVITY CLINIC



Finding written information about LANs; foiling attempts to penetrate networks; a better way to monitor program usage; a handy disk-based reference tool for LAN installations.

How to send data over regular telephone wires

My office is faced with an entrenched bureaucracy that is frozen with fear at the thought of pulling new cables to give us connections for our PCs. Is there any way to use the wires that are now carrying voice telephone calls for data too? We have no spare telephone wire pairs.—*Ronald Freeman; Bethesda, Maryland*

Absolutely! Data over voice is an old technology. The copper telephone wires have lots of bandwidth available at frequencies higher than those used by the human voice and ears. You can attach devices that I call "dog-whistle modems" to each telephone and pump data to the PC down the hall at 19.2 kilobits per second while you use the same local lines to call downtown and order a pizza for lunch.

These modems send high-frequency signals over the copper wires, instead of the audible tones regular modems use. These high frequencies won't pass through a voice telephone switch, but they will ride the copper wires right up to the voice switch. Then you pick them off with another data-over-voice modem. In addition to the modems, you will need some kind of data switch to route the PC traffic. The folks from Newbridge Networks, Performance Technology Development, Rose Electronics, or Itron have switches that are economical for installations from four to hundreds of nodes.

It sounds like the only problem you might have is getting the bureaucracy to give you access to the telephone closet so you can attach data-over-voice modems to the copper wires before they go into the voice telephone switch.

Several companies make data-over-voice modems, but Applied Spectrum Technologies in Minneapolis has put a lot of effort into learning how to link PCs through them. Give them a call at (612) 379-7114 for more information.

TECHS disk-based library is a handy reference tool for LAN installations

My company is in the system integration business. A growing portion of our work involves installing LANs, and some of our biggest problems are incompatibilities among network cards and other devices in the PC. Is there any single source of information about memory addressing, interrupts, and other points of conflicts?—*Bill Boyangton; Boulder, Colorado*

■ Telephone wires have bandwidths available at frequencies higher than those used by the human voice and ears, so you can send data over them.

The technical support staff of the companies that make network interface cards keep a lot of information about incompatibilities. But I know the frustration of being put on hold to wait for technical support.

One product you should investigate is *TECHS*, marketed by I.C.D.S. (InterConnect Data Systems) of Anaheim, California. *TECHS* is a database library of products—mainly hardware—combined with a point-and-shoot interface. The library includes information on many network adapter cards, *NetWare*, and other LAN products.

Through the *TECHS* interface, you can query the library on known incompatibilities among products and, more importantly for a lot of LAN work, on how to change variables such as the memory address, IRQ address, and other factors. One of the most impressive features of the package is its ability to bring up a diagram of the adapter card showing DIP switch and jumper locations.

Two possible drawbacks to *TECHS* are that it isn't cheap and that it doesn't cover every piece of hardware ever created. The first criticism is relative. The basic package lists for $995. A subscription service providing updates to the database is $50 per month. If you are in the business of handling technical problems, that isn't a lot of money for a reference data set. The next version of the software will include the ability to enter your own data into the

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library so that you can expand the information on products you use frequently or include proprietary ones.

The folks at I.C.D.S. have a demonstration diskette. Phone them at (714) 777-7700 for more information.

An e-mail anomaly—and a better way to monitor program usage

I encountered a problem with the electronic mail system in Novell's *NetWare,* Version 2.0a. My name is spelled Allan, and if anyone told the Novell mail system to SEND MEMO TO ALLAN, the mail system found the word ALL followed by extra characters and refused to send the mail. It assumed that the user wanted to use the ALL feature to put mail into every mailbox but made a typing error.

I refuse to change my name to suit the computer, so I created a group named ALLAN with myself as the only member. I did not bother to give the group any trustee rights, as none are necessary. I can now receive mail since the mail program sees a group named ALLAN, but it will still send mail to ALL users.

■ It doesn't matter if your network is in the Pentagon or in an advertising agency, the threat of mischief or espionage is always there.

I also have a comment on the March 15, 1988, issue, in which Greg Campbell gave a tip to restrict the number of individuals using a program to the number of copies legally owned. This is a very clever idea, except for one shortfall. If the power to the PC workstation is disrupted or the PC freezes, the copy is not returned to the "library." Copies appear to be in use when they are not.

Another problem I have with this method is that it will not allow users on the network anything but read, open, and search rights to the program's directories. I get around this by creating the FilenamX.IN and Filenam.OUT rights in a directory where all users can read and write, such as the mail directory.—*Allan Marillier; Auckland Park, South Africa*

Another good group name you may want to consider using in such circumstances is EVERYONE.

Your comments about Greg Campbell's software-metering program are generally correct. Users with later versions of *NetWare,* Banyan's *VINES,* and some other LAN operating systems should be aware that an EXECUTE ONLY right is available for application programs.

An alternative to Greg Campbell's no-cost batch files is called TURNSTYLE from Connect Computer, which you can call at (612) 944-0181.

This $195 program uses a small (7 to 10K) resident module running in each "borrowing" workstation. The resident module periodically updates a common file on the server. If the file is not updated within a given period of time, the program assumes that the borrowing machine has quit operating and credits the software copy back into the pool. It might take 5 to 15 minutes to recognize an inactive machine. The program also can create reports on how often programs are used and who uses them.

More characters in the password foils intruders

Sometimes simple adjustments can make a big improvement in LAN security. Astute users intent on mischief quickly realize that the SUPERVISOR log-in name on Novell's *NetWare SFT* (system fault tolerant) 2.1 LANs grants unlimited power. All that's necessary is to guess the correct password.

Limiting the number of consecutive incorrect log-in attempts is an excellent security feature, but a patient penetrator can try a limited number of log-ins at frequent intervals without alerting the security or error-reporting system.

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work hackers off the scent is to allow the normal user's password length to remain at the default setting of five characters. Then set the SUPERVISOR's password length to six, seven, or more characters. Now both the password itself and its length are unknown. This simple adjustment easily makes a break-in an order of magnitude more difficult.—*Anthony Kadysewski; Drums, Pennsylvania*

It doesn't matter if your network is in the Pentagon or in an advertising agency, the threat of mischief or espionage is always there. Security consultants recommend using large passwords and changing them often. Obviously, adding characters to the password exponentially increases the odds of using educated guesses to break in. Of course physical protection of passwords is important, too. Crooks don't have to guess very hard if the current password is written on a desk calendar.

Productivity Tip

IBM's Token-Ring wiring scheme isn't considered good because of its throughput or because of the "orderliness" of its protocol. It's good because you can connect together *everything* Blue with it—today. For many people, that's good enough.

Here's one alternative to the TeleVideo Systems PCS1 clone

We operate terminals that emulate the PC screen and keyboard, which are attached to slave cards in the host. Each terminal has a standalone parallel printer attached. We use both the COM port and serial host port on some stations for a second serial printer, mouse, and modem. The TeleVideo PCS1 terminal supports all of these functions concurrently.

My dealer tells me that TeleVideo stopped selling these terminals and we can't find a suitable replacement. We tried TeleVideo's new 965 and a Wyse 60, but they either don't have enough ports or the right graphics. We need a terminal with a parallel printer port, a DTE serial port, a DCE serial port, and the ability to display monochrome graphics. Does anyone make a PCS1 clone?—*John F. Malone; Bethel, Alaska*

The folks at Alloy Computer Products have a lot of interest in ASCII terminals emulating PC graphics: they market these terminals with their PC-Slave/286 cards. But they can't find an exact replacement for the TeleVideo PCS1 either. One possible alternative is the Wyse 99GT, with two serial ports and Hercules graphics.

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hard to understand why TeleVideo pulled the plug on the PCS1. Believe me, this is a product whose time has come, not one that should be discontinued.

Begin LAN management research before you install your network

I read your connectivity articles all the time, but is there a book you recommend that puts all of this information in one place?—*William Derrik; Oakton, Virginia*

I wrote a LAN book once. It, like the three other computer books I wrote, was out of date a month after it hit the shelves. This experience leads me to contend that magazines are generally the best source of information about fast-moving technologies such as LANs. The majority of book publishers still take too long to go from manuscript to bookshelf. If a product-oriented book reaches the shelves when people need the information, it was written too early to be useful. If the author waited to gather lots of good information about the real shrink-wrapped product, the book is out of date.

Some specialty publishers can move the process along more quickly. One pamphlet I am impressed with is the *LAN Management Setup Guide for Novell Networks* published by Saber Software. This 26-page publication is loaded with good information that you should know before you tackle *NetWare*. It includes information about mapping drives, creating log-in scripts, using the DOS environment, and using batch files. It makes a great reference for experienced and novice *NetWare* administrators. To order a copy, send $9.95 to Saber Software, P.O. Box 9088, Dallas, TX 75209.

When you order the book, Saber also sends you information about their "menu system." They should change the name of the product, though, because it does much more than just present menus.

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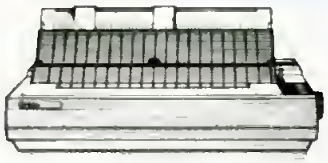
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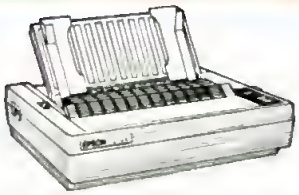
Epson FX-850

- Narrow-carriage 9-pin, dot-matrix printer
- SmartPark,™ a unique Epson paper-handling innovation, lets you switch from fanfold to single sheets or envelopes without removing hardware or paper.
- With a standard push feed tractor and single sheet friction feed, the FX-850 can handle virtually any type of paper as well as envelopes.
- Exclusive SelecType front control panel puts popular printer features and SmartPark operations at your fingertips.
- The FX-850 prints 264 characters per second (CPS) in high-speed draft mode (12 CPI), 54 CPS in Near Letter Quality mode (12 CPI).



Epson FX-1050

- Wide-carriage 9-pin, dot-matrix printer
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- With a standard push feed tractor and single sheet friction feed, the FX-1050 can handle virtually any type of paper as well as envelopes.
- Exclusive SelecType front control panel puts popular printer features and SmartPark operations at your fingertips.
- The FX-1050 prints 264 characters per second (CPS) in high-speed draft mode (12 CPI), 54 CPS in Near Letter Quality mode (12 CPI)



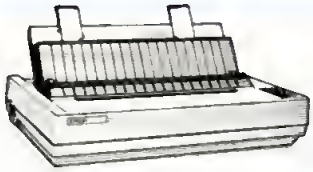
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Epson LQ-850

- Epson's 24-pin, dot-matrix technology creates true letter quality characters
- Epson's SmartPark™
- Exclusive SelecType front control panel offers quick, easy selection of popular typestyles, fonts and pitch
- 264 Characters per second in the high-speed draft mode delivers outstanding productivity
- 88 Characters per second in Letter Quality mode for enhanced, high-resolution characters
- In draft mode or Letter Quality mode, the LQ-850 runs at a surprisingly quiet 55 dB noise level



Epson LQ-1050

- Epson's 24-pin, dot-matrix technology creates true letter quality characters
- Epson's SmartPark™
- 264 Characters per second in the high-speed draft mode delivers outstanding productivity
- 88 Characters per second in Letter Quality mode for enhanced, high-resolution characters
- In draft mode or letter quality mode, the LQ-1050 runs at a surprisingly quiet 55 dB noise level
- Exclusive SelecType front control panel offers quick, easy selection of popular typestyles, fonts and pitch



Epson LQ-2550

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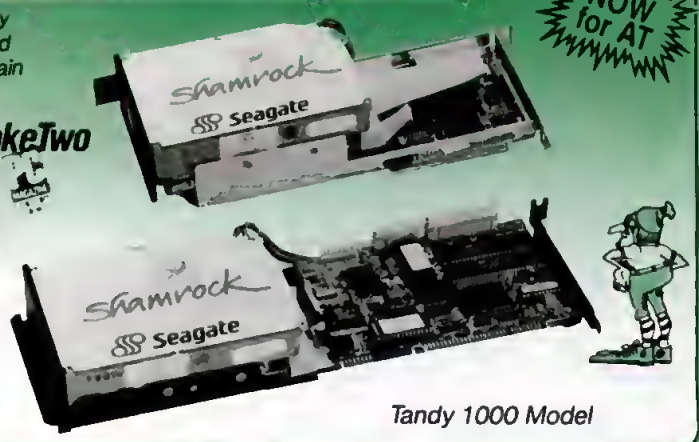
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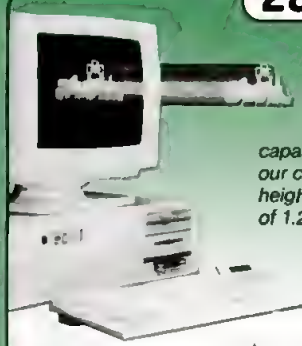
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- 80287 math coprocessor support
- Choice of enhanced 101-key, AT-style, or 5151 keyboard
- 17.6 on Norton's SI Benchmark 4.0 test

$1895

386/16 System	MGA	EGA	VGA
40MB, 28ms	$2,449	$2,799	$2,999
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- Choice of enhanced 101-key, AT-style, or 5151 keyboard
- 13.7 on Norton's SI Benchmark 4.0 test

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286/12 System	MGA	EGA	VGA
20MB, 65ms	$1,399	$1,699	$1,899
40MB, 40ms	$1,579	$1,879	$2,079

CompuAdd 286/10

- 80286 processor running at 10MHz or 6MHz, switchable system speeds
- 512KB RAM expandable to 1MB
- CompuAdd INTEGRATOR productivity software package
- Choice of 5.25" 1.2MB or 3.5" 1.44MB floppy drive
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- 80287 math coprocessor support
- Choice of enhanced 101-key, AT-style, or 5151 keyboard
- 9.4 on Norton's SI Benchmark 4.0 test

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286/10 System	MGA	EGA	VGA
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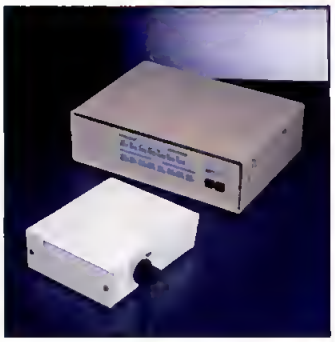
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80287-10	*10Mhz, for 286*	269
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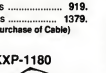
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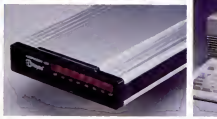
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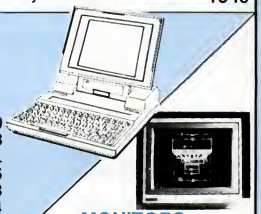
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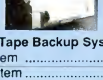
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World Port 1200 Ext	159
World Port 2400 Ext	259
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Laplink Plus	99

PRINTERS

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ALO 324E	699
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NEC P2200 Parallel	329
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Color Kit 5200/5300	109
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TOSHIBA 311	NEW
321 SL	$ TOO LOW
341 SL	TO PRINT
KENSINGTON Printer Stand	20
★ With Printer	10 ★

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PLUS HARD CARD: 20 MB	499
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TOSHIBA 3 5" Internal with Universal mounting kit 720K/1 44 MB	99/109
SEAGATE: For PC/XT HALF HT	
PRO PACK 20 MB (ST 225)	259
PRO PACK 30 MB (ST 238)	279
Fully Pretested, PRO PACK includes controller, cables, detailed & illustrated menuel	
PC/XT Mtng Kit & Filler Plate	10

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BITCOMM 3 Ver 3 5 - 5 25"	29
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LOGI Paint/LOGI Cadd	29/49
LOGITECH Publisher	49
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SHARP FO-220	649
SHARP UX-180	869
SHARP FO-420	1199
SHARP UX-350	1199
MURATA M1200/M1600	629/729
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JT Fax Board 9600	549
JT Fax Portable 4800	349
THE COMPLETE PC Fax Board 4800	249
Fax Board 9600	469

MONITORS

LOGITECH AutoSync with EGA Card, LogiMouse & Paint Show	569
MITSUBISHI D Scan 1371	429
Diamond Scan 1381	479
Diamond Scan Tilt & Swival - add	20
NEC 1402 MultiSync II	599
1403 MultiSync 2A Super VGA	499
1404 MultiSync 3D	699
MultiSync PLUS	899
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Sony 1311 to IBM Cable	20
SONY Multiscan 1303	549
SONY Multiscan 1302	649
Sony 1303/2 to IBM Ceble	20
Sony 1303/2 to MAC II Cable	30
ZENITH ZCM-1490 Flat Screen	599
Zenith Tilt & Swivel	30
UNIVERSAL Tilt & Swivel	20

KEYBOARD/MOUSE

KEYTRONIC 101 Plus Professional for PC/XT/AT	109
OEM Version. Identical to 101 with 90 dey warrenty from us	69
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LOGITECH PS/2 Mouse	75
C-7 Serial or Bus	85
HiRez Bus	89
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80287-8 AT 8 Mhz	215
80287-10 AT 10 Mhz	239
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80387-20 for 386 machines	469
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DISPLAY CARDS

ATI VGA Wonder (256k)	319
GENOA SuperEGA HiRes + Version 4880-9	199
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Pro Designer VGA Plus	429
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MODEMS

Also See Under Lap Tops

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TOUCHBASE SYSTEMS World Port Pocket 1200 Ext	159
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2400 External w/sw	149

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PANASONIC
1091i-m2 **$175** | *1124* **Call**

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Complete PC 400 dpi
$155

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NEC LC890	Call
Panasonic 1080i-m2	184
1091i-m2	175
1124	314
1191	245
1592\1595	392\418
1524	515
Toshiba 321-SL	489
341-SL	695
351-SX	929
351-C	1019
ExpressWriter 301\311	315\379

MONITORS

Amdek 1280 & Card	639
210A	87
Hitachi 20" SuperScan	2090
Mitsubishi Diamond Scan 1381	477
Moniterm Viking	Call
NEC Multisync II A	Call
Multisync 3D	Call
Multisync GS	185
Others	Call
Packard Bell	
12" Amber	79
RGB HiRez Color	225
VGA 720x480	399
Princeton Ultra Sync	485
Samsung	Call
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Multiscan 1303	475
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SOFTWARE

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Carbon Copy Plus	103
Clarian Pro Developer	344
Clipper	398
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Dac Easy 3.0	58
dBase IV	448
DesignCad	145
Deskilnk	92

SOFTWARE (cont.)

DesqView	89
Drafix 1 Plus	Call
Drafix Ultra	Call
Drafix 3D Mod & Options	Call
Dollars & Sense	95
Easy Xtra	54
Excel PC	281
FastBack	89
FastBack Plus	97
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Freelance Plus	293
Fox Base Plus	179
GEM Draw Plus	159
Generic Cad Level III w/Dot	129
Generic Cadd Others	Call
Harvard Graphics	255
King Quest IV	35
Laplink Plus	74
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Lotus 123 2.01	Call
Lotus Agenda	Call
Managing Your Money	113
MathCad 2.0	195
MicroSoft Flight Sim	35
MicroSoft Windows 2.0	56
MS-Dos 4.01	109
Norton Util 4.0	48
Novell Netware 286	Call
PageMaker 3.0	Call
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PFS: Professional Plan 1.02	81
PFS: Professional Write 2.0	102
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Q&A Write	115
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Quicken	29
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Turbo Basic	62
Turbo C	92
Turbo Pascal 5.0	97
Ventura Publishing 2.0	458
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Windows	Call
WordPerfect 5.0	213
XTree	33
XTreePro	58
XTreeNet	Call

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(replacing Tiger Tablet)
4-Btn Cursor , 1-Btn Pen & Mouse Emulator.
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1025 / 1043-DM	Call
Drawing Brd 12x12 16-Btn	369
Enter Sweet-p 600	598
Houston Instruments	
DMP 40	Call
DMP 52MP	Call
DMP 52	Call
DMP 81	Call
DMP 62	Call
Options	Call
Hitachi Puma Tab (10-Year Warranty)	
PumaPro 12x12,4btn,Pen,SW	339
PumaPro 12x12,12btn,SW	369
Ioline	Call
JDL 650 Series	Call
Kurta IS 12x12	285
IS 12x17	485
Summagraphics 12x12 Plus	329
18x12 Pro w/4 Butt & Stylus	559
Mac Bit Pad 12x12, 4But,Sty	269


T-1000
$769

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Complete PC 400dpi Scanner	175
Logical Connection 256/512k	Call
ScanMen 400 dpi	179
Kensington Masterpiece Remote	105

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Original Programs - utilities, applications, etc. Earn royalities in just 90 days.
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Complete PC Fax	398
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Panasonic FAX Board	689
Seagate ST225 w/card	260
ST238 30Mb w/card	285
Sharp Fax UX-140 & Phone	969
Smart Modem 1200B int w/sw	59
2400B int w/sw	115
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3.5" 1.44Mb Drive	95
5.25" 360k Drive	75
5.25" 1.2Mb Drive	87
US Robotics	Call

BOARDS & NETWORKS

3-Com Etherlink	Call
Adage AD10/4	Call
AD10/8L	Call
ArcNet	Call
Artist	Call
AST	Call
ATI VGA Wonder 256 & 512	Call
VIP VGA	249
Copy II Opt Board Dlx	95
EtherNet Plus	Call
Genoa VGA 760x1024	379
Hercules Graphics Plus	169
Intel AboveBoard 286/512k	359
AboveBoard PS 286/512k	398
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VGA Plus	Call
VGA Plus 16	Call
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Sigma Designs VGA	209
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T1000	769
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SuperSport 286 40Mb	Call

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Genuine & New

8087-2	122
80287-8	195
80287-10	223
80387-16	355
80387-20	Call
80387-25	518
80387-SX	339
80C287A (for Laptops)	299

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Logitech C7 Serial or Bus	59
HiRez Bus	69
HiRez Serial	Call
Bus & Paint	69
Serial & Publisher	94
"Ergo" Mouse	89

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40 ms equiv. for most optiDrives

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dBase IV ... 449
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Quattro ... 149

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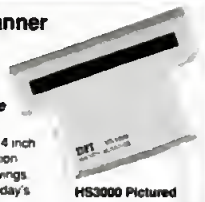
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The HS3000 offers a full 4 inch window at 400dpi resolution Scan photos logos, drawings etc Can be used with today's most popular applications

HS3000 Pictured

HS3000	Handy Scanner	$199.95
DMS200	200DPI 3-Button Ser Mouse	$49.95
DMS200S	200DPI 3-Button Ser Mouse w/Dr HALO Software	$59.95

Pentagon Systems, Inc. Security Access Card for IBM PC/XT/AT and Compatible Computers



• The SAC1 is an access control card that prevents unauthorized access to your computer through user passwords • Protects your computer against intrusion and corruption attempts • Allows up to 10 programmable passwords • Menu driven • Manual included • One Year Warranty

SAC1	Security Access Card	$149.95

Intel Connection Coprocessor, Modem, Inboard 386/PC & Above Board PLUS



CB6000 Pictured

CB6000 only Send/receive FAXes or EMAIL and keep computing while all this runs in the background Easy-to-use menu-driven software Includes 256K RAM

CB6000	Connection Coprocessor	$799.95
CB6010	Modem Option for CB6000	$289.95
IB1200	Inboard 386/PC w/1MB RAM	$699.95
MB4320	Above Board 286 PLUS with 512K RAM	$429.95
MB4420	Above Board 286 PLUS multi-function board w/ 512K RAM	$529.95

Star Multi-Font Dot Matrix Printer



• 9-pin dot matrix print head • Centronics parallel interface • Epson or IBM modes • Print in Courier Sanserif, Orator 1 and 2 condensed Pica Elite and Italic in all modes

NX1000		$199.95

Jameco Switch Boxes

• Female Connectors
• All Pins Switched



JE1170 Pictured

Part No	Description	Price
JE1170	DB25 pin A/B Switch	$22.95
JE1171	DB25 pin A/B/C Switch	$27.95
JE1172	DB25 pin A/B/C/D Switch	$29.95
JE1173	Centronics36 pin A/B Switch	$24.95
JE1174	Centronics36 pin A/B/C Switch	$27.95

Jameco 256K Smart Parallel Printer Buffer and Parallel/Serial Converters



PP256 Pictured

PP256 • 256K RAM high speed buffer accepts data from your computer at a very fast rate and outputs it to your printer while you keep working • Female 36 pin Centronics connectors SP100 & PS100 • Serial to Parallel and Parallel to Serial Converters • Feature one female DB25 and one male 36-pin Centronics connector

PP256	256K Parallel Printer Buffer	$199.95
SP100	Serial to Parallel Converter	$59.95
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IBM PC/XT/AT Compatible 111-Key Enhanced Keyboard with Calculator

NEW

With Solar Calculator!



JE2016 Pictured

JE2016 (only): • Solar powered calculator offers ease and convenience of use • 111-key • Enhanced keyboard layout • Tactile touch keyswitches • 12 function keys • Illuminated LED indicators for Num Lock, Caps Lock and Scroll Lock • Separate cursor pad • Low profile design • Switchable between PC/XT or AT

JE2016	Enhanced 111 Key PC/XT/AT Keyboard with Calculator	$79.95
JE1016	Enhanced 101-Key PC/XT/AT Keyboard	$69.95
JE1015	Standard 84-Key PC/XT/AT (AT layout) Keyboard	$59.95

IBM COMPATIBLE DISPLAY MONITORS

AMBER	12" Amber Mono	$99.95
CTX2410	14" RGB 640x200	$279.95
TM5154	EGA 14" 720x350	$399.95
JE1059	EGA Monitor & Card	$519.95
TM5155	14" Multiscan 800x560	$499.95
QC1479	14" VGA 720x480	$449.95
JE2055	VGA Monitor & Card	$649.95

NEW



QC1479 Pictured

JAMECO IBM PC/XT/AT COMPATIBLE CARDS

JE1041	20/40MB Hard Disk Controller Card (PC/XT)	$79.95
JE1043	360K/720K/1.2MB/1.44MB Floppy Disk Controller Card (PC/XT/AT)	$49.95
JE1044	360K Floppy Hard Disk Controller Card (PC/XT)	$129.95
JE1045	360K/720K/1.2MB/1.44MB Floppy Hard Disk Controller Card (AT)	$149.95
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JE1052	Color Graphics Card w/Parallel Printer Port (PC/XT/AT)	$49.95
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GC1500	Orchid 8 Bit VGA Card w/256K Video RAM (PC/XT/AT)	$299.95
GC1501	Orchid 8/16 Bit VGA Card w/256K Video RAM (PC/XT/AT)	$349.95
JE1060	I/O Card w/Serial, Game, Printer Port & Real Time Clock (PC/XT)	$59.95
JE1061	RS232 Serial Half Card (PC/XT)	$29.95
JE1062	RS232 Serial Half Card (AT)	$34.95
JE1065	I/O Card w/Serial, Game and Parallel Printer Port (AT)	$59.95
JE1071	Multi I/O Card w/Controller & Monochrome Graphics (PC/XT)	$119.95
JE1061	2MB Expanded or Extended Memory Card (zero-K on board) (AT)	$119.95

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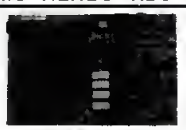
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ST225XT Pictured

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ST238XT	30MB w/Controller (PC/XT)	$299.95	
ST238AT	30MB w/Controller (AT)	$389.95	
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ST251XT	40MB w/Controller (PC/XT)	$419.95	
ST251AT	40MB w/Controller (AT)	$489.95	
ST251-1	40MB Fast 28ms (Drive only)	$499.95	
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ST277XT	60MB w/Controller (PC/XT)	$499.95	
ST277AT	60MB w/Controller (AT)	$589.95	

IBM PC/XT/AT COMPATIBLE MOTHERBOARDS



JE3025 Pictured

JE1001	4.77/8MHz (PC/XT)	$89.95
JE1002	4.77/10MHz (PC/XT)	$109.95
JE3005	Baby 8/12MHz (AT)	$329.95
JE3010	Baby 8/16MHz *NEAT* (AT)	$469.95
JE3020	Baby 16MHz 80386 (AT)	$1199.95
JE3025	Baby 20MHz 80386 (AT)	$1499.95
JE3026	Full-Size 25MHz 80386 (AT)	$2299.95

IBM PC/XT/AT COMPATIBLE 3.5"/5.25" DISK DRIVES



JE1022 Pictured

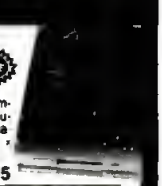
352KU	3.5" 720KB (PC/XT/AT)	$109.95
356KU	3.5" 1.44MB (PC/XT/AT)	$129.95
JE1020	5.25" 360KB (PC/XT/AT) Black	$89.95
JE1021	5.25" 360KB (PC/XT/AT) Beige	$89.95
JE1022	5.25" 1.2MB (PC/XT/AT) Beige	$99.95

IBM PC/XT/AT COMPATIBLE MODEMS

1200P	1200/300 Baud Pocket-Size Modem (PC/XT/AT)	$99.95
1200H	1200/300 Baud Internal Modem w/MaxiMite Comm Software (PC/XT/AT)	$69.95
2400H	2400/1200/300 Baud Internal Modem w/MaxiMite Comm Sftwr (PC/XT/AT)	$129.95
1200C	1200/300 Baud External Modem w/MaxiMite Comm Sftwr (PC/XT/AT)	$99.95
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SALE



• For use with IBM PC/XT/AT and compatible computers • Double-sided, double density • 135TPI • 160 tracks • Rotation speed 300rpm • Size 4"W x 6"D x 1"H

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• Includes universal mounting hardware and installation kit

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SA30		$379.95

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DJ10	40MB Tape Back Up and Tape	$349.95
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VGAP	VGA Paint Program	$119.95

Computer Accessories



JE1200 Pictured

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JE1199	Tilt Swivel Monitor Base	$11.95
JE1200	Tilt Swivel Mon Base w/Pwr Ctr	$39.95
JE1203	Metal Keyboard Drawer	$34.95
JE1204	Adjustable Copy Holder	$14.95
JE1205	80 Column Printer Stand	$13.95
JE1206	132 Column Printer Stand	$14.95
JE1207	Adjustable CRT Stand	$59.95

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JE1017	Flip-Top Baby AT Case ~~$69.95~~	$54.95
JE1019	Slide Baby AT Case ~~$69.95~~	$59.95
JE1030	150 watt PC/XT Power Supply	$59.95
JE1032	200 watt Baby AT Power Supply	$89.95
JE2010	Tower Case w/250 watt Pwr Supply	$299.95

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41256-120	262,144x1 (120ns) ~~$11.05~~	$8.95
41256-150	262,144x1 (150ns) ~~$11.49~~	$8.49
UPD70108-5	(5MHz) V20 Chip (Replaces 8088)	$7.49
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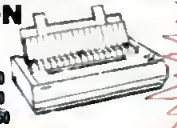
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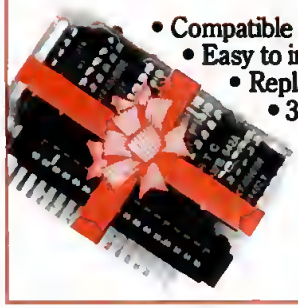
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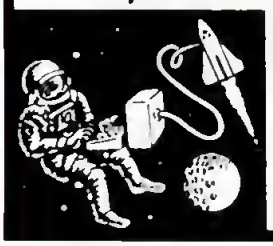


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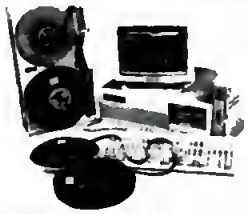
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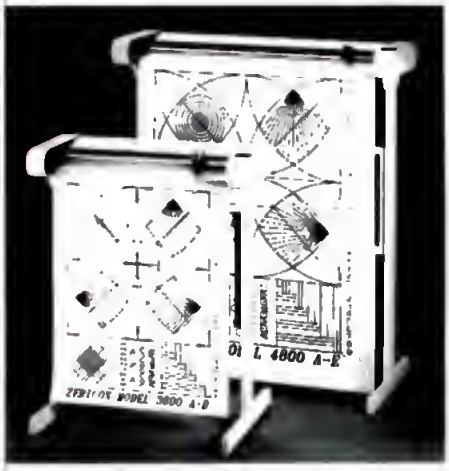
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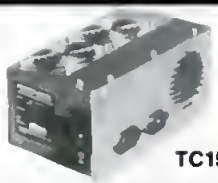
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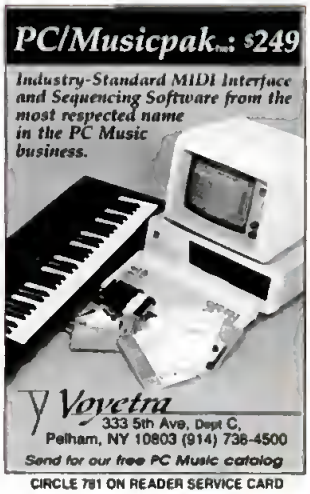
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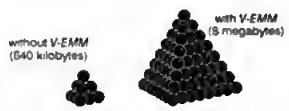
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COMING UP

386 COMPUTER BLOCKBUSTER It was inevitable. After a year and a half of celebrating the virtues of the 80386 microprocessor, *PC Magazine* finally devotes an entire issue to the technology, the performance, and the potential of the 386-based machine.

This review promises to be the most comprehensive 386 roundup to date, encompassing over 100 desktop machines from nearly 60 companies. We'll give you the straight dope on the systems themselves, and editor-in-chief Bill Machrone will analyze the 386 microprocessor's impact on computing today. Anyone who is smugly waiting for this chip to be killed off by the 486 invasion may be surprised at our predictions for its future.

GUIDELINES FOR BUYING A 386 A sidebar by executive editor Bill Howard provides guidance on what components to look for when buying your 386-based system. He explores the pros and cons of mail-order midrange and high-end purchases, and gives pointers on how to select your monitor, video adapter, hard disk, and modem—and how to choose among third-party boards. In another sidebar, editorial assistant Susan Hayes illustrates the substantial differences between list and street prices you can find if you take the time to shop around.

386SX COMPUTERS *PC Magazine* staff writer Catherine Miller discusses the design and marketing of the 80386SX processor—the chip designed to relegate the 80286 to the lower tier of PC microprocessing. What plans are in store for this chip, especially in light of the recent 386SX price dip? See our table of comparative prices, where a 386SX-based machine can cost even less than a similarly configured 286.

386 PERSPECTIVES Our benchmark tests and features table provide the ultimate price/performance information, and we compare 386s with one another and with their predecessors. Via benchmark tests and a time line, *PC Magazine* traces the PC path from 1890 to today. PC

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1. In which of the following sectors does your organization operate? (Check one.)
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- e. ☐ Engineering/R&D
- f. ☐ Finance/Accounting
- g. ☐ Marketing/Sales
- h. ☐ Administrative/General Management

3. Is your company a reseller?
- i. ☐ Yes
- j. ☐ No

4. For how many IBM PCs and compatibles do you specify brands of products?
- k. ☐ 10 or less
- l. ☐ 11–25
- m. ☐ 26–100
- n. ☐ 100 or more

5. Are there any PCs in your office? (Check all that apply.)
- o. ☐ Linked to mainframe
- p. ☐ Linked to mini
- q. ☐ Networked together

6. Does your company own
- r. ☐ Mainframe(s)
- s. ☐ Mini(s)

7. Do you plan to buy any PC products?
- t. ☐ Now
- u. ☐ In 4 to 6 months
- v. ☐ In 6 to 12 months
- w. ☐ No definite plans

8. Number of employees in your entire company?
- x. ☐ 25 or less
- y. ☐ 26–99
- z. ☐ 100–499
- 1. ☐ 500–999
- 2. ☐ 1000 or more

PC 5/16-4

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PC 5/16-3

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PC MAGNET

CIRCLE 497 ON READER SERVICE CARD

AFTER HOURS

EDUCATION

Breaking Through The Silence: Sign Language Quiz Gives You the Tools

BY PAULA SEEFELDT

Learning any new language requires time, effort, and attention to detail. *Sign Language Quiz* ($59), from Data Assist, provides the tools for learning American Sign Language; all the user needs is discipline.

SLQ teaches the alphabet, the numbers one to ten, and simple words. Lessons consist of practice sessions, simulated flashcards, a multiple-choice option, and a word list.

A sign-language novice begins to develop familiarity with the gestures through practice sessions. Signs are flashed on the screen for 10 seconds, and you indicate the corresponding character by tapping the appropriate keyboard key. While this can be endlessly frustrating in the beginning, it becomes easier with repetition.

As you become more adept at recognizing signs, the quizzes become trickier. Signs can be displayed randomly instead of in sequence, and the Immediate Retry feature can be disabled, allowing you only one chance at a correct answer.

If even this proves too tame, you can create additional lessons using the original files. Once you master simple words, words like "dog" and "cat" may seem too easy. If so, you can simply expand the file for an enhanced, more-complex vocabulary list.

Although occasionally monotonous, *Sign Language Quiz* is effective. After a few hours, sign language proficiency is within your grasp.

List Price: *Sign Language Quiz*, $59. **Requires:** 384K RAM; CGA, EGA, MCGA, or VGA graphics; DOS 2.0 or later. Not copy protected. Data Assist, 651-G Lakeview Plaza Blvd., Columbus, OH 40385; (614) 888-8088.

CIRCLE **425** ON READER SERVICE CARD



Sign Language Quiz *displays the hand gestures that make up American Sign Language. The graphics are clear and detailed.*



TRACON's controls and indicators closely simulate the environment that air traffic controllers work in. Here the screen is emulating the LAX traffic control sector.

GAMES

TRACON: Air Traffic Simulator Isn't for the Faint of Heart

BY JEFF PROSISE

You've flown *Flight Simulator;* now take a seat on the other side of the stick with *TRACON*, Wesson International's new air traffic control simulator. *TRACON* (Terminal Radar Approach CONtrol) is so realistic you'll need a cup of coffee and all the nerve you can muster to direct air traffic in some of the U.S.A.'s busiest air corridors.

The object of *TRACON* is to guide all of the aircraft in your sector safely to their destinations. You're the link between local airport control towers and "center control." Local towers direct landings once you've positioned a plane at an airport's FAF (Final Approach Fix) point with the proper altitude and approach vector. You grant departing flights clearance to take off and direct them once they're in the air. For extra realism, *TRACON* also throws in overflights—flights that cross your sector en route to another destination.

TRACON's graphics are superb. The *TRACON* screen looks much like a real air traffic controller's radar scope, with blips representing aircraft positioned over an aerial map of the sector. Information on inbound flights and requests for takeoff appear in the pending stack about 5 minutes before they need attention.

Because everything happens in real time, the simulation has all the elements of a pressure cooker. Flights must remain separated by a distance of no less than 3 miles horizontally and 1,000 feet vertically to avoid separation conflicts. Using a series of mouse-driven pop-up menus (or commands issued from the keyboard), you control each plane's heading, altitude, and airspeed. Dialogue with the pilots scrolls by in a window at the bottom of the screen. How precisely your commands are carried out depends upon the weather conditions, the skill level of the pilots, and aircraft performance characteristics.

At start-up, *TRACON* defaults to the busy LAX sector surrounding Los Angeles. You may also choose to direct traffic in control sectors around Boston, Miami, Chicago, and San Francisco. You set the degree of difficulty by deciding how many aircraft to handle in how many minutes, weather conditions, pilot proficiency, and wind speed and direction.

If the worst befalls you—if you permit two planes to encroach a safety zone a half-mile long by 500 feet high—*TRACON* ends the simulation by informing you how many lives were lost and dumps you back to the DOS prompt. If this sounds exciting, then *TRACON* is for you. You won't get a better feel for what an air traffic controller's life is like without climbing into a real tower. PC

List Price: *TRACON*, $49.95. **Requires:** 256K RAM, graphics adapter, DOS 2.0 or later. Not copy protected. Wesson International, 1439 Circle Ridge, Austin, TX 78746; (512) 675-7220.

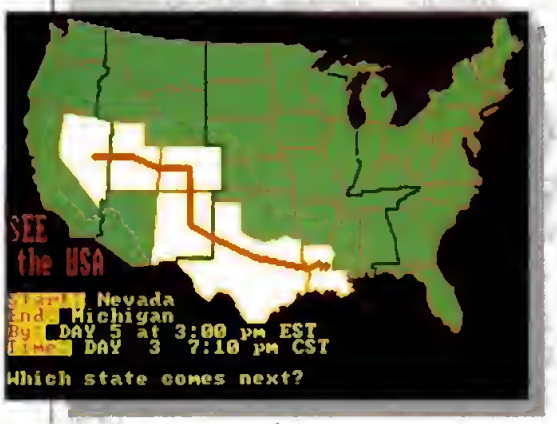
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AFTER HOURS



You move around in See the USA by typing the name of a state that borders your current location.

EDUCATION

For Armchair Travelers: See the USA Takes You on a Tour of America

BY SUSAN HAYES

Ever thought about packing the kids in the backseat of your station wagon and heading cross-country? After all, what better way for them to learn about the 50 states than to experience them firsthand? Sounds like a great idea until you consider the less inspiring sights and sounds of car travel, like hot, tired children and miles of highway with no bathroom in sight.

If you would prefer a less physically taxing excursion, try Compu-Teach Corp.'s *See the USA*, a geography game that allows you to leave the car in the garage.

A CGA map of the United States appears on your screen and as you use the keyboard arrows to move around the map, the names of the states or capitals you pass through appear on the screen.

When you're ready to play for real, you are given a starting state and a destination state, and you move across the country (unhampered by traffic) by typing the name of a state that borders the state you're presently in. If you correctly identify a border state, the game moves you to the new state. A colorful illustration depicting some activity or place associated with the state celebrates your arrival.

See the USA's Quiz Game tests your knowledge of birds, facts, mottos, and people associated with the states. Using the arrow keys to propel yourself to the correct state, you're given four chances, as well as clues, to identify the correct answer. But because the program only sporadically flashes the names of the states on the screen, it can sometimes be difficult to figure out whether you're in Rhode Island or New Jersey.

What makes *See the USA* a super tool in the classroom as well as an appealing game in the home is the ability to edit the sample questions, as well as to create your own set of questions, provided the answer is a state or a capital.

Although not quite the same as standing on the edge of the Grand Canyon, *See the USA* is a great geography lesson that proves the old adage "learning can be fun."

List Price: *See the USA*, $49.95.
Requires: 256K RAM, CGA graphics, DOS 2.0 or later. Not copy protected. Compu-Teach Corp., 78 Olive St., New Haven, CT 06511; (800)-44-TEACH.

CIRCLE **423** ON READER SERVICE CARD

EDUCATION

Audubon Society Offers Software That Teaches the Bear Facts

BY DON TRIVETTE

Can you identify any bear not wearing a fire warden's hat? You'll be able to after playing *Audubon Wildlife Adventures: Grizzly Bears*.

The Audubon Society, one of the nation's leading environmental groups, has contracted with Advanced Ideas of Berkeley, California, to produce educational software highlighting various conservation issues. *Grizzly Bears* is their first joint product, but it will soon be followed by a program on whales and another on sharks.

Bears' main menu offers several games that make learning about our furry friends a challenge. Each selection aims to teach specific facts about the grizzly, its habitat, and the ecology of the forest. In Grizzly Bear Mystery, you are a wildlife student working in a park laboratory. A dead grizzly has been found at Elmo Creek near the Full Moon Resort. You must investigate the death. There's no shortage of suspects: Joseph Bighorn, rancher; Fred Moon, resort owner; Sylvia Nimrod, hunter; Len Smith, photographer; and Malcom Widener, a resort guest.

Each seems to have a motive. For example, a bear has been killing the rancher's livestock. By questioning the suspects and examining the clues, you can deduce the identity of the murderer. The solution varies; each time you play, there'll be a different culprit.

Grizzly Bears is designed for the home and school markets (grades 4 to 12), and that explains—but doesn't excuse—its biggest flaw. The developer chose antiquated three-color CGA graphics because, he contends, educational institutions can't afford EGA/VGA. Perhaps, but the awful color detracts mightily from an otherwise good product.

In case you're confronted by a bear before you get to this software, you should look for a humped shoulder, a concave face, and long curved front claws. That's how you'll know you are face-to-face with a dangerous grizzly and not Smokey.

List Price: *Audubon Wildlife Adventures: Grizzly Bears*, $49.95.
Requires: 256K RAM, CGA graphics, DOS 2.1 or later. Not copy protected. Advanced Ideas Inc., 2902 San Pablo Ave., Berkeley, CA 94702; (415) 526-9100.

CIRCLE **424** ON READER SERVICE CARD

In a Grizzly Bears scenario, a grizzly has been found dead near Elmo Creek; as a wildlife student, it's up to you to solve the mystery. This map shows the location of several suspects.



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AFTER HOURS

EDUCATION

Math Education Package for Young Scholars Can Be Customized

BY M. STEPHANIE RICKS

Math Word Problems, by Weekly Reader Software/Optimum Resource, develops mathematical and cognitive skills in 7- to 11-year-old students. Its building-block approach to elementary-level mathematics strengthens a student's understanding of basic math.

Math Word Problems ($49.95) is divided into four skill levels, three of which offer equations of increasing difficulty. The main menu lets the user select a skill level, the number of tries for each problem, and whether or not an on-screen calculator may be accessed. Level 1 confronts the student with simple one-step math problems. In Level 2, two-step equations are introduced. Level 3 presents problems that require three separate functions.

Level 4 is a blank template with room for 25 customized problems that can spotlight a student's weaknesses. An Option menu gives users the choice of limiting practice to problems that emphasize addition, subtraction, multiplication, or division only.

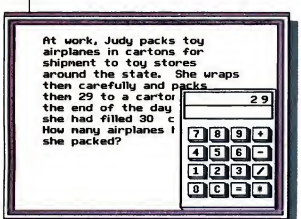
A tap of the Spacebar accesses an on-screen calculator. Parents and teachers from the "old school" may elect to turn off this feature, so that the student is forced to master the mechanics of solving an equation. However, if a student is completely stumped, *Math Word Problems* will walk him through a problem by highlighting numbers and typing out equations before listing the final answer. Trivia items are littered throughout the program and offer a nice respite from the drills.

In the classroom, *Math Word Problems* can be used to facilitate test preparation and print out test papers. It also tracks the progress of up to 40 students. A Report Card option lists the number of problems attempted by a student and the number answered correctly.

Math Word Problems' repetitive instruction gives the student an organized and workmanlike course of study for honing basic math skills.

List Price: *Math Word Problems*, $49.95. **Requires:** 128K RAM, CGA or EGA graphics, DOS 2.0 or later. Copy protected. Weekly Reader Software/Optimum Resource Inc., 10 Station Pl., Norfolk, CT 06058; (203) 542-5553.

CIRCLE **421** ON READER SERVICE CARD



At Level 1, Math Word Problems provides the user with an on-screen calculator for help with simple computations.



The diagnostic tests found in the Writing Skills Improvement Program *resemble standardized exams. In this section, you decide why the sentence reads poorly.*

EDUCATION

Rx for Better Writing: Software Diagnoses, Treats Prose Problems

BY JENNIFER ZAINO

When it comes to the written word, folks tend to be more judgmental than they are about everyday speech. Lapses in style and usage are somehow much more forgivable when spoken rather than written.

While you could rely on style-checking software to police your writing for errors in grammar, usage, and style, Optimum Resource's *Writing Skills Improvement Program* uses a series of diagnostic tests and electronic "workbook" exercises to teach you to recognize these mistakes yourself. The $59.95 package also includes *The Little, Brown Handbook*, one of the standard references on English grammar, usage, and composition.

The first thing you'll do is take a diagnostic test (three are included). The 60-question format is reminiscent of many standardized exams. Anything from improperly situated commas to subject/verb agreement to misplaced modifiers is tested here. If you cannot complete the test in one session, you can save it and return to it at a later time. The software retains the answers you have input but inconveniently does not return you directly to the point at which you ended the test.

The program evaluates your answers after each test and directs you to the appropriate sections in *The Little, Brown Handbook* for further study. The errors you made also determine which of the electronic workbook exercises you'll need to complete.

This automatic appraisal is ideal for pointing out weak spots, but there's no way to access the workbook exercises in areas in which you have shown no deficiencies. That's unfortunate for those who would like to sharpen their skills by doing additional exercises.

The package seems a little high-priced, especially considering that you can purchase a copy of *The Little, Brown Handbook* for about $17 and work through similar exercises on your own. Of course, if you're looking to quickly pinpoint your weak spots, you'll want a copy of this software.

List Price: *Writing Skills Improvement Program*, $59.95. **Requires:** 256K RAM, DOS 2.0 or later. Not copy protected. Weekly Reader Software/Optimum Resource Inc., 10 Station Pl., Norfolk, CT 06058; (203) 542-5553.

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EDUCATION

Algebra and Calculus Review Helps Students Build Math Prowess

BY STEPHANIE IZAREK

Sylvester leaves Philadelphia, driving toward Atlantic City, a city about 60 miles away, at the speed of 70 miles per hour. Fred leaves Atlantic City at the same time, driving toward Philadelphia at a speed of 55 miles per hour. How long do they drive before they meet?

If this problem doesn't make you break into a cold sweat, consider trying *Algebra*, Version 3.0, or *Calculus*, Version 3.0, from True BASIC. If the problem of Sylvester and Fred's rendezvous left you huddled in a corner, however, steer clear of these packages.

These study aids ($49.95 each) are intended for users who have a working knowledge of the two subjects and would like an extra tool to expand their understanding. *Algebra* and *Calculus* are useful for checking homework assignments or studying for SAT exams.

Algebra and *Calculus* are similar in design; both use a simple menu-driven interface. There are three windows on the screen at all times: one at the bottom to display messages, one on the left to display text and input functions, and one on the right for displaying graphs.

From either program's main menu you can select a specific topic or opt for a more general subject area. In addition, the main menu offers options for saving or replaying practice sessions. Both packages come with prerecorded practice sessions that you can review. These sessions are a great way to acquaint yourself with a new area of study.

A dialog box is used to enter numbers and functions and to execute problems. Data can be easily edited as it is entered, and the only potential difficulty is with remembering to use the correct arithmetic symbols when defining a function. If you use the wrong symbols, you could end up creating a function entirely different from what you intend. Fortunately, the manuals include a complete listing of all acceptable symbols and a brief description of their use.

The only real difference between the two programs is in the subject matter. *Algebra* focuses on teaching and practicing elementary and intermediate concepts, such as slope, systems of linear equations, and quadratic equations. You can examine, evaluate, and graph user-defined functions. The program also has a built-in calculator.

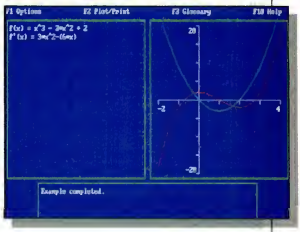
Calculus focuses on freshman-level calculus and encourages free exploration of topics including the concept of limits, L'Hopital's rule, exploring and visualizing parametric equations, and differential equations. As with *Algebra*, you can define, analyze, and graph your own functions.

On the downside, the prerecorded practice sessions accompanying *Algebra* and *Calculus* are displayed too quickly for you to grasp what is happening the first time you watch them.

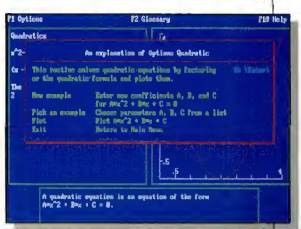
Both *Calculus* and *Algebra* are wonderful programs because of their plotting capabilities, which allow you to visualize the concepts you are studying. *Algebra* and *Calculus* are exceptional study aids at a reasonable price. Their benefits far surpass those gained from using a calculator and workbook alone.

List Price: *Algebra*, Version 3.0, and *Calculus*, Version 3.0, $49.95 each. **Requires:** 256K RAM, graphics adapter, DOS 2.0 or later. Not copy protected. True BASIC Inc., 39 S. Main St., Hanover, NH 03755; (800) TR-BASIC.

CIRCLE **420** ON READER SERVICE CARD



True BASIC's study tool, Calculus, incorporates plotting ability to illustrate key concepts.



Two excellent features of True BASIC's Algebra are the context-sensitive, pop-up Help and Glossary screens.

AFTER HOURS INDEX

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On the back cover of this magazine, you'll find a 4-page ad about our 386™ systems, 286 systems, laser printers, and low direct-from-the-manufacturer prices. And if you like what you see, we have a 28-page catalog you'll like even more. Just send the card below, and we'll send you a free copy. Or call (800) 426-5150. In Canada, call (800) 387-5752.

DELL COMPUTER CORPORATION

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   E ☐ DP/MIS Manager
2. Which products are you most interested in?
   A ☐ 286 architecture
   B ☐ 386 architecture
3. Are you interested in computer products for:
   A ☐ Home
   B ☐ Business
4. How many PCs do you have installed now?
   A ☐ 1-10
   B ☐ 11-20
   C ☐ Over 21
5. How many PCs do you (your company) plan to purchase in the next twelve months?
   A ☐ 1-10
   B ☐ 11-20
   C ☐ Over 21
6. Is your requirement:
   A ☐ Immediate
   B ☐ 1-3 Months
   C ☐ Over 3 Months
   D ☐ Info only

AD CODE 51B34

IF YOU CAN'T CALL, WRITE.

On the back cover of this magazine, there's a 4-page ad for Dell Computer Systems. It invites you to call our toll-free number, so you can get our free 28-page catalog. But if you'd rather send this card, that's fine with us. Just fill it out, and we'll get a catalog to you right away.

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Technically speaking, the Dell System 325 is the most advanced 386™ computer we've ever built.

And, according to PC Magazine, it's one of the most advanced 386 computers they've ever tested.

In benchmark after benchmark, the System 325 ran circles around a field of 386-based 25 MHz systems. A field that included the Compaq^ 386/25.

A show of prowess that earned the System 325 PC Magazine's Editor's Choice award.

It was a goal we set for ourselves from the very beginning. And an objective anyone with a penchant for power and performance can appreciate.

A PERSONAL COMPUTER THAT'S REALLY PERSONAL.

Of the more than 150,000 personal computers we've sold to date, each and every one has been individually configured to fit the needs of its owner.

The System 325 takes that idea to its logical extreme.

For example, it runs either MS-DOS,® OS/2, or our own Dell UNIX® System V. Which is compatible with AT&T's System V Interface Definition. And the whole world of XENIX® applications.

If speed is of the essence, we can include an optional Intel^ 80387 or WEITEK 3167 math coprocessor.

And since nothing about this system is lightweight, the mass storage is a 90 MB ESDI disk drive. Or we can configure it with a 150 or 322 MB unit.

As you might expect, the output is just as intense. You can choose between VGA mono with paperwhite screen, or VGA Color Plus, for high resolution colors displayed on a larger screen.

Even though the System 325 gives you all this performance, it still leaves you six open slots for whatever else you might want to add.

And once you've told us what you want, we'll make sure what you want works—by burning-in the entire system unit.

THE DELL 386 SYSTEM 325 HAS A 25 MHz CLOCK RATE, CACHE MEMORY CONTROLLER, 90 MB 18ms ESDI DRIVE, PAGE MODE INTERLEAVED MEMORY, AND 100% COMPATIBILITY WITH MS-DOS, OS/2 AND UNIX SYSTEM V.



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PC MAGAZINE EDITOR'S CHOICE

"The new top-of-the-lin Dell System 325 is a flagship worth putting out in front of the fleet."

For the full story, see inside back cover.

February 14, 1989

